

THE HOPE REPORTS

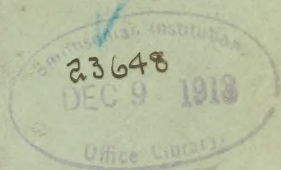
VOL. VII

1908—1910

EDITED BY

EDWARD B. POULTON, D.Sc., M.A.
HON. LL.D. PRINCETON, V-P.R.S., V-P.L.S., F.Z.S., F.G.S., F.E.S.

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SOCIO HONORÁRIO DE LA REAL SOCIEDAD ESPAÑOLA DE HISTORIA NATURAL
CORRESPONDING MEMBER OF THE ACADEMY OF SCIENCE, NEW YORK, AND
THE SOCIETY OF NATURAL HISTORY, BOSTON



OXFORD

PRINTED FOR PRIVATE CIRCULATION

BY HORACE HART, PRINTER TO THE UNIVERSITY

1910



ALF^d ROBINSON, DEL.

THE MAKERS OF THE HOPE DEPARTMENT
OXFORD UNIVERSITY MUSEUM

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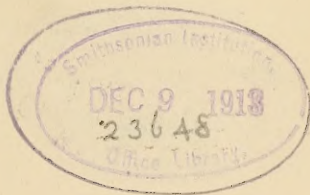
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P R E F A C E

THE seventh volume of Hope Reports contains publications of the appropriate octavo size that have appeared between June 1908 and June 1910. But for the pressure of work I should have brought out the volume at an earlier date and in a more convenient size.

Dr. Dixey's important Anniversary Address to the Entomological Society, on the scent-distributing scales of male Pierine butterflies, the summary of many years of laborious investigation, heads the series of thirty-seven memoirs. It is succeeded by seven papers (3-9) on the bionomics of the Lepidoptera, chiefly concerned with mimicry in butterflies. All of these appeared in the 'Transactions of the Entomological Society of London' in 1908 and 1909. Mimicry in African butterflies is the subject of two papers (3 and 5), including the Rev. K. St. Aubyn Rogers's important and fully illustrated memoir on British East African examples (5). Mimicry in North American butterflies is the subject of a third (4), while Mr. J. C. Moulton's interesting and well-illustrated account of some of the chief mimetic combinations in Tropical America is a fourth (6). Dr. Longstaff's valuable memoir (7) contains a great variety of bionomic observations on butterflies in many parts of the world, while Mr. Guy A. K. Marshall's (8) and

Mr. Eltringham's (9) papers deal with the direct evidence on which the theories of mimicry and warning colours are built. Mr. Marshall has kindly allowed me to include in this volume his masterly and comprehensive survey (8) of the recorded attacks of birds upon butterflies. It is appropriate that the monograph should appear in this book, for it contains an account of all the available material in the Hope Department, and of many observations made by Oxford workers. Furthermore, its appearance has been called forth by discussions which in recent years have arisen over the work of the Department.

Important investigations upon the systematics of Orthoptera, carried out or promoted by Mr. R. Shelford, appear in the succeeding group of memoirs (10-18). Of these, 10-13A are concerned with the *Blattidae*, a family on which Mr. Shelford is the leading authority. Mr. Shelford has also contributed one paper (14) on the *Mantidae*. Dr. Hancock, of Chicago, has contributed a further monograph (15) on the *Tetriginae*, a peculiar group of grasshoppers (*Acridiidae*), in the University Collections; while Dr. Achille Griffini, of Genoa, has written three valuable papers (16-18) on the Oxford material belonging to the Locustid genus *Gryllacris*.

The section above described is followed by a series of short papers extracted from 'The Entomologist's Monthly Magazine'. Three of these (19-21) record Mr. Hamm's very interesting observations on the courtship of Empid flies, while one (22) contains his notes on the pursuit of

a *Cerceris* by a Tachinid fly. The latter, turning out to be a species new to Britain, forms the subject of a paper (23) by Mr. C. J. Wainwright. Mr. Hamm also describes (24) a new variety of the beetle *Sitaris muralis*. Commander Walker's valuable notes on the most interesting British Lepidoptera in the classical 'Dale Collection' are recorded in four papers (25-28), including the butterflies, and the moths as far as the Noctuina. Two papers (29 and 30) by Mr. W. J. Lucas give an interesting account of the dragon-flies in the same great collection. Mr. F. C. Woodforde describes (31) a new form of the British Geometrid moth *Ephyra pendularia*, and Commander Walker adds a second supplement (32) to his valuable list of the beetles of the Oxford district.

Numerous extracts from the 'Proceedings of the Entomological Society of London' for 1908 and 1909, arranged in order of date, are divided into three periods (33-35). The subject of each communication has been defined with much care in the Contents, so that any further description is here unnecessary. It will be observed that the majority of the communications and exhibitions were of bionomic interest.

This volume of Reports includes neither Mr. Marshall's nor Dr. Dixey's papers on Reciprocal Mimicry in the 'Transactions of the Entomological Society of London'. I have been hitherto prevented by other work from taking my part in this controversy, but hope that a paper of mine may appear side by side with those mentioned above, in

the next volume of Hope Reports. In the meantime a brief statement of some of the chief arguments will be found in the abstracts from the 'Proceedings' (33-35).

The progress of the Department in 1908 and 1909 will be found in the two annual Reports of the Hope Professor (36 and 37).

EDWARD B. POULTON.

HOPE DEPARTMENT OF ZOOLOGY,
UNIVERSITY MUSEUM, OXFORD,
June 20, 1910.

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1. Preface.
2. The Plume-scales of the *Pierinae*. The Presidential Address read before the Entomological Society of London at the Annual Meeting, Jan. 19, 1910, by Dr. F. A. Dixey, D.M., M.A., F.R.S., &c., Fellow and Bursar of Wadham College, Oxford. (From 'Proceedings of the Entomological Society of London', 1909, p. lxxxvii.)
3. Heredity in six families of *Papilio dardanus*, Brown, Subspecies *cenca*, Stoll, bred at Durban by G. F. Leigh, F.E.S., by Professor Edward B. Poulton, D.Sc., M.A., Hon. LL.D. Princeton, V-P.R.S., V-P.L.S., &c., Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford. (From 'Transactions of the Entomological Society of London', 1908, p. 427.)
4. Mimetic North American species of the Genus *Limnitis* (s. l.) and their models, by Professor Edward B. Poulton. (From 'Transactions of the Entomological Society of London', 1908, p. 447.)
5. Some bionomic notes on British East African Butterflies, by the Rev. K. St. Aubyn Rogers, M.A., F.E.S., Wadham College, Oxford; with further notes and descriptions by Professor E. B. Poulton, and an Appendix containing the description of new British East African forms, by Roland Trimen, Hon. M.A., F.R.S., &c. (From 'Transactions of the Entomological Society of London', 1908, p. 489.)
6. On some of the principal Mimetic (Müllerian) Combinations of Tropical American Butterflies, by J. C. Moulton, F.E.S., Magdalen College, Oxford. (From 'Transactions of the Entomological Society of London', 1908, p. 585.)
7. Bionomic notes on Butterflies, by Dr. G. B. Longstaff, D.M., M.A., F.R.C.P., F.E.S., New College, Oxford. (From 'Transactions of the Entomological Society of London', 1908, p. 607.)
8. Birds as a Factor in the Production of Mimetic Resemblances among Butterflies, by Guy A. K. Marshall, F.Z.S., F.E.S. (From 'Transactions of the Entomological Society of London', 1909, p. 329.)
9. An Account of some Experiments on the Edibility of certain Lepidopterous Larvae, by Harry Eltringham, M.A., F.Z.S., F.E.S., New College, Oxford. (From 'Transactions of the Entomological Society of London', 1909, p. 471.)

10. Studies of the *Blattidae*. X. A revision of the Old-World *Blattinae* belonging to the *POLYZOSTERIA* group, by R. Shelford, M.A., F.L.S., F.Z.S., F.E.S. (From 'Transactions of the Entomological Society of London', 1909, p. 253.)
11. On a small collection of *Blattidae* in the Naturhistorischen Museum zu Wiesbaden, by R. Shelford. (From 'Jahrbücher des Nassauischen Vereins für Naturkunde in Wiesbaden', vol. 61, 1908, p. 27.)
12. Some new species of *Blattidae* in the Brussels Museum, by R. Shelford. (From 'Mémoires de la Société entomologique de Belgique', tome xv, 1908, p. 227.)
13. Descriptions of some new genera and species of *Blattidae*, by R. Shelford. (From 'Deutsche Entomologische Zeitschrift', 1909, p. 611.)
- 13A. *Blattidae* of Spanish Guinea, by R. Shelford. (From 'Memorias de la Real Sociedad Española de Historia Natural', tomo i, 1909, p. 475.)
14. Two remarkable forms of Mantid oothecae, by R. Shelford. (From 'Transactions of the Entomological Society of London', 1909, p. 509.)
15. Further studies of the *Tetriginæ* (Orthoptera) in the Oxford University Museum, by J. L. Hancock, M.D., F.E.S. (Chicago). (From 'Transactions of the Entomological Society of London', 1908, p. 387.)
16. Studi sui *Grillacridi* del Museo di Oxford. Parte I^a. Specie etiopiche, indo-malesi ed australiane, by Dr. Achille Griffini (R. Istituto tecnico, Genova, Italy). (From 'Atti della Società Italiana di Scienze Naturali', vol. xlvii, 1908, p. 300.)
17. Two new species of *Gryllacris* in the University Museum, Oxford, by Dr. Achille Griffini. (From 'Annals and Magazine of Natural History', ser. 8, vol. iii, April, 1909, p. 366.)
18. Révision des types de certaines *Gryllacris* décrites par F. Walker, existant au Musée d'Oxford, by Dr. Achille Griffini. (From 'Deutsche Entomologische Zeitschrift', 1910, p. 82.)
19. Observations on *Empis livida*, by A. H. Hamm, Assistant in the Hope Department. (From 'Entomologist's Monthly Magazine', 1908, Second Series, vol. xix, p. 181.)
20. Observations on *Empis opaca*, by A. H. Hamm. (From 'Entomologist's Monthly Magazine', 1909, Second Series, vol. xx, p. 132.)

21. Further observations on the *Empinae*, by A. H. Hamm. (Ibid., p. 157.)
22. *Setulia grisea*, Mg. and *Cerceris arenaria*, L. in the New Forest, by A. H. Hamm. (Ibid., p. 273.)
23. *Setulia grisea*, Mg., a Tachinid new to Britain, and its allies, by Colbran J. Wainwright, F.E.S. (Ibid., p. 275.)
24. *Sitaris muralis*, Forst., n. var. *flava*, by A. H. Hamm. (Ibid., p. 277.)
25. Some notes on the Lepidoptera of the 'Dale Collection' of British insects, now in the Oxford University Museum: I. RHOPALOCERA, by James J. Walker, Hon. M.A., R.N., F.L.S., F.E.S. (From 'Entomologist's Monthly Magazine', 1907, Second Series, vol. xviii, pp. 93 and 130.)
26. Some notes on the 'Dale Collection' of British insects, now in the Oxford University Museum; II. HETEROCERA; Sphingina, by J. J. Walker. (Ibid., p. 154.)
27. II. HETEROCERA (continued); Bombycina, by J. J. Walker. (Ibid., 1909, vol. xx, p. 106.)
28. II. HETEROCERA (continued); Geometrina and Noctuina, by J. J. Walker. (Ibid., p. 175.)
29. Notes on the British Dragon-flies of the 'Dale Collection', by W. J. Lucas, B.A., F.E.S. (From 'Entomologist's Monthly Magazine', 1908, Second Series, vol. xix, p. 198.)
30. Notes on the British Dragon-flies of the 'Dale Collection' (II), by W. J. Lucas. (Ibid., 1909, vol. xx, p. 79.)
31. A new aberration of *Ephyra pendularia*, L., by F. C. Woodforde, B.A., F.E.S. (Ibid., 1910, vol. xxi, p. 114.)
32. Second Supplement to the Preliminary List of the Coleoptera of the Oxford District, by James J. Walker, Hon. M.A., R.N., F.L.S. (From 'Report of the Ashmolean Natural History Society of Oxfordshire', 1909, p. 59.)
33. Extracts from the 'Proceedings of the Entomological Society of London', Feb.—June, 1908, containing the following communications:—
 - a. Feb. 3, 1908.—1. On very young larvae of *Sitaris muralis*, obtained by Mr. A. H. Hamm from ova laid by females while in captivity, by Commander J. J. Walker.
 2. *Pyralis lienigialis* at Oxford, by J. J. Walker.

3. Suggested Mimicry in Bourbon Butterflies, by Lieut.-Col. N. Manders, R.A.M.C., F.Z.S., F.E.S.
 4. Mimicry in the Butterflies of Mauritius and Bourbon, by Professor Edward B. Poulton.
 5. Secondary Mimetic Resemblance of *Ithomiinae* to the Danaine genus *Iluna*, by Professor E. B. Poulton.
 6. Mimetic Relation of *Nychitona* and *Pseudopontia*, by Dr. F. A. Dixey.
 7. Abstract of paper in the Transactions, On Diaposematism, with reference to some limitations of the Müllerian Hypothesis of Mimicry, by Guy A. K. Marshall, F.Z.S., F.E.S.
 8. Discussion on the above paper by Professor E. B. Poulton (including an account of Mr. S. A. Neave's observations on the habits of *Pseudacraea poggei*, and the blue species of *Crenis*, with their mimic) and Dr. F. A. Dixey.
- b. April 1, 1908.—Observations on the habits of *Ochromyia jejuna*, and on the structure of its tongue, by Mr. E. E. Green, F.E.S., communicated by Professor E. B. Poulton.
- c. May 6, 1908.—1. *Blattidae* in Amber, by R. Shelford.
2. Mr. S. A. Neave's discovery of a remarkable Oestrid fly (*Spathicera*) following *Rhinoceros bicornis*, by Professor E. B. Poulton.
 3. Mr. H. Leslie Andrewes's observations on the Bulbul feeding its young on specially protected insects, by Professor E. B. Poulton.
 4. Dr. Karl Jordan's observations on predaceous Asilid flies, by Professor E. B. Poulton.
 5. On the species of *Neptis* in the Islands to the E. and the N.W. of Madagascar, by Professor E. B. Poulton.
 6. Mimicry in Bourbon Butterflies, by Lieut.-Col. N. Manders.
 7. Types of *Oxygastris*, by W. J. Lucas, B.A., F.E.S.
- d. June 3, 1908.—1. Communication of Further Studies of the *Tetriginae* (Orthoptera) in the Oxford University Museum, by Dr. J. L. Hancock (Memoir No. 15).
2. Communication of Mimicry in Tropical American Butterflies, by J. C. Moulton (Memoir No. 6).
 3. Communication of Heredity in *Papilio dardanus* from Natal, bred by Mr. G. F. Leigh, F.E.S., of Durban, by Professor E. B. Poulton (Memoir No. 3).

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34. Extracts from 'Proceedings of the Entomological Society of London', Oct.-Dec., 1908, containing the following communications :—
- a. Oct. 7, 1908.—1. Mimicry of the *melpomene*-like *Heliconii* by other groups of South American Butterflies, by Dr. F. A. Dixey.
 - 2. Communication of Bionomics of Butterflies, by Dr. G. B. Longstaff (Memoir No. 7).
 - b. Oct. 21, 1908.—1. Mr. G. F. Leigh's proof of the specific identity of *Charaxes neanthes* and *C. zoolina*, by Professor E. B. Poulton.
 - 2. Discussion of the above communication, together with a revision of the species of *Charaxes* of the *zoolina*-group, by Dr. Karl Jordan, Ph.D., F.E.S.
 - 3. Communication of On Müllerian Mimicry and Diaposematism : a reply to Mr. G. A. K. Marshall, by Dr. F. A. Dixey.
 - 4. Reply to the above communication, by Guy A. K. Marshall.
 - c. Nov. 4, 1908.—1. A Phasmid bred parthenogenetically by Mr. H. Main, by R. Shelford.
 - 2. The Double or Combined Aposeme, by Dr. F. A. Dixey.
 - 3. Mr. E. L. Clark's discovery of *Glocia clarki* near Durban, by Professor E. B. Poulton.
 - 4. Mr. S. A. Neave's observations on a mimetic *Euphaedra*, by Professor E. B. Poulton.
 - 5. *D. chrysippus* and its mimics taken together on a patch of Zinnia at Jinja on the N. shore of the Victoria Nyanza by Mr. C. A. Wiggins, by Professor E. B. Poulton.
 - d. Nov. 18, 1908.—1. Exhibition of species of *Charaxes* of the *zoolina*-group, by Dr. Karl Jordan.
 - 2. Mimetic relation between *Colaenis telesiphe*, *Heliconius telesiphe*, &c., by Dr. F. A. Dixey.
 - e. Dec. 2, 1908.—1. Mr. Keynes's observations on the drinking habits of *Limenitis*, by Professor E. B. Poulton.
 - 2. Mimicry by *Colaenis telesiphe* and *Belenois thysa*, probably Müllerian, by Dr. F. A. Dixey.
35. Extracts from 'Proceedings of the Entomological Society of London', Mar.-Dec., 1909, containing the following communications :—
- a. Mar. 3, 1909.—1. A Mendelian experiment on *Acidalia virgularia*, by L. B. Prout, F.E.S., and A. Bacot, F.E.S., an exhibition of

- the extensive material presented by the authors to the Hope Department.
2. Discussion on the above, by Mr. A. Harrison, F.L.S., F.E.S., and others.
 3. Abstract of Birds as a Factor in the production of Mimetic Resemblances in Butterflies, by Guy A. K. Marshall (Memoir No. 8).
 4. Discussion of the above by W. E. Sharp, Dr. T. A. Chapman, W. J. Kaye, Commander J. J. Walker, and others.
- b. Apr. 7, 1909.—1. An exhibition of mimetic Oriental *Blattidae* and their Coleopterous models, by R. Shelford.
2. Abstract of On Reciprocal Mimicry: a rejoinder to Dr. F. A. Dixey, by G. A. K. Marshall, a continuation of the discussion on the Müllerian theory.
 3. Discussion of the above by C. J. Gahan, S. A. Neave, J. W. Tutt, and others.
- c. May 5, 1909.—1. The Oestrid fly of the Rhinoceros, by S. A. Neave. M.A., B.Sc., F.E.S., Magdalen College, Oxford.
2. The forms of *Danaida chrysippus* from Egypt and the Sudân (Jan.-Feb., 1909), by G. B. Longstaff, D.M., F.R.C.P., F.E.S., New College, Oxford.
- d. June 2, 1909.—1. A migration of Ladybirds observed 40 miles above Khartûm (Feb. 16, 1909), by Dr. G. B. Longstaff.
2. An Arabian species of *Scarabaeus* (*S. compressicornis*) taken in Egypt, near the Sphinx, by Dr. G. B. Longstaff.
 3. Exhibition of a carved Egyptian scarab obtained by Dr. Longstaff in Upper Egypt, by Professor E. B. Poulton.
 4. Exhibition of species of two genera of *Coccinellidae* captured *in coitu*, by Professor E. B. Poulton. The species were *Adalia obliterata* and *Halysia 18-guttata*, beaten out of a fir-tree at Tubney by Joseph Collins of the Hope Department (Aug. 5, 1908).
 5. Exhibition of Diptera from Oxford and the New Forest, bred or captured by A. H. Hamm, of the Hope Department, by Professor E. B. Poulton.
 6. Exhibition of *Castnia thearon*, a rare moth bred from a S. American orchid and captured by Dr. A. R. Wallace in his orchid-house at Broadstone, Dorset, by Professor E. B. Poulton.

7. *Eurytela hiarbas* (Drury, 1782), a probable form of *E. dryope* (Cramer, 1775), by Professor E. B. Poulton. Fresh evidence by G. F. Leigh, F.E.S., of the two forms being observed *in coitu*.
 8. Remarkable breeding experiment conducted by Rev. K. St. Aubyn Rogers, M.A., F.E.S., Wadham College, Oxford, on *Hypolimnas misippus*, by Professor E. B. Poulton.
 9. Müllerian mimicry in *Euplocina*, by Professor E. B. Poulton.
 10. Small moths captured at sea, probably 190 miles from the land they had left, by Professor E. B. Poulton. An exhibition of specimens collected by, and publication of observations made by F. Muir, F.E.S., and J. C. Kershaw, F.E.S.
 11. F. Muir's and J. C. Kershaw's notes on the life-history of *Aulacodes simplicialis*, by Professor E. B. Poulton.
 12. The use of the saw by a sawfly during oviposition, by Professor E. B. Poulton.
- e. Oct. 6, 1909.—1. 15 *Charaxes neanthes* and 6 *C. zoolina* bred from eggs laid by a *zoolina* female, by G. F. Leigh, F.E.S. An unfortunate error in the number of the offspring is corrected in red ink.
2. Communication of Edibility Experiments with larvae and lizards, by H. Eltringham, M.A., F.Z.S., F.E.S., New College, Oxford (Memoir No. 9).
- f. Oct. 20, 1909.—Communication of Two Remarkable Forms of Mantid oothecae, by R. Shelford (Memoir No. 14).
- g. Nov. 3, 1909.—Three species of *Planema* (*Acracinae*) and their Nymphaline (*Pseudacraea*) and Papilionine mimics taken on a single day (July 11, 1909) by C. A. Wiggins, F.E.S., by Professor Poulton.
- h. Nov. 17, 1909.—1. Mimetic relations of certain East and West African butterflies, by Harry Eltringham.
2. Probable mimetic association of Aculeate Hymenoptera captured on the flowers of a single tree, near Jericho, by Rev. F. D. Morice, M.A., F.E.S., Queen's College, Oxford.
 3. Exhibition of a teratological specimen of a Carabid beetle from Ceylon, by Dr. G. B. Longstaff.

- i. Dec. 1, 1909.—Exhibition of late autumn Coleoptera from Wytham Park, by Commander J. J. Walker.
36. Report of the Hope Professor of Zoology for 1908. (From the 'Oxford University Gazette'.)
37. Report of the Hope Professor of Zoology for 1909. (From the 'Oxford University Gazette'.)

THE PRESIDENT'S ADDRESS.

LADIES AND GENTLEMEN,

WHILE the political storm rages without, it is a relief to turn aside into a haven where party feeling holds no sway, and where all are ready to co-operate in the single purpose of the advancement of our subject.

My first duty is to congratulate the Society at large on the continuance of its prosperity. Our Meetings during the past year have been excellent in point of attendance; one of them, if I mistake not, constituting a record for recent times. The communications made to us have been of great interest and high scientific importance. It is difficult to select any of these for special mention without seeming to be invidious; I cannot, however, refrain from expressing the appreciation we must all feel for the work done by Mr. Doncaster, Mr. Bacot and Mr. Prout on the laws of inheritance; by Mr. G. A. K. Marshall on birds in relation to mimicry; and, in another province of our study, for the minute and careful investigation of the relations of well-known species which we owe to Dr. Chapman and Mr. Tutt. Not the least valuable lesson to be learnt from the work of these two gentlemen, and other labourers in the same field, is that even among the most familiar objects of our interest there still remain many problems to be solved, and much untrodden country yet to be explored.

All who have had experience of the working of such societies as our own, know how greatly their success depends on the efforts of those whom, leaving out of sight the occupant for the time being of the Presidential Chair, I may call the active Officers. This Society has never been slow to acknowledge its obligations to its Secretaries, Treasurer and Librarian for their constant devotion to its interests, a devotion which

involves, as I well know, the expenditure of much time and trouble. At the conclusion of my first year of office I wish to add to the thanks of the Society an expression of my own personal gratitude for the assistance and support I have received at all times from those gentlemen I have mentioned, and from my other colleagues on the Council and Publications Committee. One and all have united to make the task of your President an easy and pleasant one to fulfil.

During the past year several of our number have dropped out of the ranks. We have to deplore the loss of Captain FREDERICK HALLAM HARDY, R.A.M.C., whose Fellowship of the Society dates only from 1908; of JOHN BROWN, noted for his special knowledge of the old fen fauna, and H. G. PALLISER who joined us in 1886 and 1893 respectively.

Another of our Fellows, H. W. BARKER, who died on September 21st, at the age of 49, was well known to many entomologists as the active and efficient Honorary Secretary of the South London Entomological and Natural History Society from 1886 to 1893, and also as an industrious collector of British Lepidoptera. He had been a Fellow of our Society since 1887.

One summer day, many years ago, as I was wandering about country lanes, a schoolboy with a butterfly-net, I was accosted by a pleasant-looking young man, who, after asking me what success I had had, bestowed on me some excellent advice as to where to go and what to look for. At parting he gave me his card, and invited me to call on him. The name on the card was H. C. LANG. I never saw him again, but I have always remembered his kindness to a stranger whose only claim on him was the freemasonry of entomologists. The news of his sad death within the last few weeks has come as a great shock not only to all who have ever been brought into personal contact with him, but also to all who realise how much he has done to create and foster among British entomologists an interest in the butterfly fauna of Europe. The Rev. Henry Charles Lang, M.D., was, I believe, a Fellow of this Society in early days, and after an interval rejoined us in 1900.

Outside the circle of our own Society, we have to lament

the decease of Dr. J. H. BAILEY, well known for his work on the Coleoptera of the Isle of Man.

Transatlantic entomology has suffered a severe loss in the death of the veteran traveller and naturalist W. H. EDWARDS, who passed away at the age of 87. It is well for us to remember that it was the narrative of his early travels on the Amazon that helped to inspire Bates and Wallace to undertake their famous expedition in that region. Those of us who know Edwards's splendid volumes on the Butterflies of North America will, I think, agree that the plates in that work reach a point of excellence that in their way has never been surpassed.

Another veteran on last year's death-roll is the great coleopterist Professor GUSTAV KRAATZ of Berlin. It is pleasant to remember that he was a Fellow of our Society for over thirty years, only resigning after failing eyesight had practically put an end to his active work. He died on November 2nd of last year at the age of 78. We all remember the sympathetic words which fell from his friend, Dr. Karl Jordan, on the occasion of the announcement of his decease to this Society. An appreciative account of his life and work from the pen of Dr. Jordan appears in the current issue of one of the entomological monthlies.

Lastly, we cannot, as naturalists, pass over without notice the death of Professor FRITZ RÖMER, Director of the Frankfurt Museum of Natural History, who died on the 20th of March after a short illness. His services to that Institution were very great, and his admirable personal qualities endeared him not only to his colleagues, but also to all who sought assistance from his wide and varied learning.

It would not be possible for me in the time at my disposal to notice a tenth part of the publications interesting to Entomologists that have appeared during the past year. Important works by Fellows of our own Society are "Mendel's Principles of Heredity," by Professor Bateson, whom we are glad to congratulate on his appointment as Director of the John Innes Horticultural Institution at Merton, and "Charles Darwin and the Origin of Species," by our former President, Professor Poulton. The latter book, issued on the fiftieth

anniversary of the appearance of the "Origin," is a worthy memorial of the three great Darwin commemorations which have lately claimed so much of our attention, and with which the name of our former President, Alfred Russel Wallace, still happily on our list of existing Fellows, is inseparably connected.

Of treatises published abroad, I may perhaps mention Karl Fiebrig's careful investigation of the supposed symbiosis of trees and ants, to be found in the Leipzig *Biologisches Centralblatt*; and Meisenheimer's very remarkable experiments on secondary sexual characters in Lepidoptera, recorded in his *Experimentelle Studien* published by Fischer in Jena.

The past year has been rich in events interesting to all Entomologists. A departure of great importance has been taken by the Colonial Office in the constitution of a Committee for Entomological Research, on which body several of our most distinguished Fellows are serving, and in connection with which responsible posts are held by Mr. G. A. K. Marshall and Mr. S. A. Neave. Under such auspices the enterprise cannot fail to accomplish work of the highest value. In view of the peculiar significance of this undertaking, I shall ask to be allowed to quote some words used elsewhere by me in reference to it:—

"The announcement of the appointment of this Committee will be received with much satisfaction in all quarters where the importance of a scientific basis for administrative and other official action is duly recognised. Among the advances of biological science in the last few years, none has been more remarkable than the discovery that the cause of many diseases whose nature and origin had hitherto escaped detection, was to be sought in the presence of parasitic micro-organisms of various kinds and qualities in the tissues of animals and plants. The part played by insects and ticks in the dissemination of these morbid parasites is now known to be of immense importance, and great efforts have already been made, not without success, to restrict the occurrence of malarial and other disorders by the systematic destruction of the insect-carriers of the organisms concerned. For this purpose it is essential to distinguish with accuracy between various closely-allied species; and it is here that the work of the

skilled entomologist proves its necessity. It was well remarked by Dr. A. E. Shipley, in his recent Presidential Address at Winnipeg to the Zoological Section of the British Association, that 'a few years ago no knowledge could seem so useless to the practical man, no research more futile than that which sought to distinguish between one species of a gnat or tick and another ; yet to-day they knew that that knowledge had rendered it possible to open up Africa and to cut the Panama Canal.' This witness is true ; and it would be difficult to point to a more complete demonstration of the fact that natural knowledge pursued for its own sake, without any direct view to future utility, will often lead to results of the most unexpected kind, and of the very highest practical importance. It is this that justifies the demand that both Governments, and such private individuals as have the means, should do all in their power to encourage the study and pursuit of science as science, without waiting for such applications as may prove to be of commercial or political value. When the benefits to be derived from the scientific treatment of a subject are so manifest as in the present case, even the most indifferent of public bodies can hardly afford to stand aloof ; and it is to be hoped that the activity of the Colonial Office in this direction, begun under the auspices of Mr. Chamberlain, and culminating for the present in the recent action of Lord Crewe, may be taken as an indication that the Government of this country is becoming increasingly alive to the importance of securing the co-operation of scientific authorities in administrative measures. But beyond this, the movement will deserve a still greater welcome if it helps to emphasise the importance of encouraging the pursuit of genuine science, even when no immediate prospect is offered of material results."—*Nature*, Sept. 2, 1909, p. 278.

I take this opportunity of reminding Fellows of this Society of the existence of the Association of Economic Biologists, which deals with subjects of special concern to Entomologists. The Association held a very successful Annual General Meeting at Oxford in July of last year, under the genial presidency of Dr. A. E. Shipley.

But the crowning event for all naturalists, and indeed for all men directly or indirectly interested in Science, has been

the great celebration at Cambridge of the double anniversary of Charles Darwin,—the hundredth of his birth, and the fiftieth of the publication of the “Origin of Species.” I cannot attempt on the present occasion to do even partial justice to the immense interest of the ceremonies that marked that commemoration ;—probably the most important event of the kind that the present generation will witness. I should wish, however, to express my gratification in being permitted to bear a part in it as your accredited representative, and I take this opportunity of putting on record the terms of the Address presented to the University on your behalf. It runs as follows :—

“To the CHANCELLOR, VICE-CHANCELLOR and MEMBERS of the UNIVERSITY OF CAMBRIDGE.

“The Entomological Society of London feels greatly honoured at the invitation to associate itself with the University of Cambridge in celebrating the Centenary of her illustrious alumnus, CHARLES ROBERT DARWIN. In common with all other students of nature, Entomologists recognise in the life and work of Darwin an influence which has transformed for them the whole aspect of their labours. Every department of their field of study has been quickened into fresh life by the genius of the great naturalist whose work received its first direction within the precincts of the University of Cambridge. Insect Systematics, Morphology, Physiology, and Embryology, as pursued at the present day, all owe their significance and their aims to the illuminating doctrine of Natural Selection. The vast subject of Insect Bionomics, which affords one of the most fertile fields at present open for the interpretation of natural phenomena, dates not only its importance but its very existence from the publication of the views which found expression in the ‘Origin of Species.’ The Entomological Society of London points with pride to the fact that, while Entomologists in all parts of the world have found in the career and personality of Charles Darwin at once a stimulus and an example of unrivalled power, many of the researches which, during the past thirty years, have done most to illustrate, confirm and extend the Darwinian views of species-transformation have

been laid before the scientific world by means of the Society's own publications.

"The heartiest congratulations on the occasion of this Centenary Celebration are due and are now offered to the University of Cambridge, as the nursing mother of a man who has revolutionised thought, and whose overmastering influence has made itself felt not only in the sphere of Biological Inquiry, but also in those of Physics, of Politics, and of Philosophy."

In the composition of the above Address I had the great advantage of the assistance of Professor Poulton, and of one of our former Vice-Presidents, the Rev. F. D. Morice.

I must not omit to mention that another of our ex-Presidents, Lord Walsingham, the recent transfer of whose magnificent collection of microlepidoptera to the National Collection is one of the chief events of the Entomological year, took a prominent part in the proceedings as High Steward of the University of Cambridge.

Certain coming events demand our notice. We are proposing to hold another *Conversazione* next May, when the experience we have gained will no doubt enable us to ensure an even more successful result than on the last occasion. I need hardly impress upon those present the desirability of hearty co-operation towards this end.

It is to be hoped that some of our number will be able to attend the International Zoological Congress to be held at Graz next August. But whether this be so or not, we ought certainly to send a strong contingent to the First International Congress of Entomology, the establishment of which is chiefly due to the tact and energy of our Vice-President, Dr. Karl Jordan. The Congress, as I think we all know, is to be held in Brussels, during the first week of August.

I now turn to the more special portion of my Address, for which I have chosen as a subject,

THE PLUME-SCALES OF THE PIERINAE.

The form of scent-distributor most characteristic of the Pierinae is the plume-scale or plumule. This is a chitinous lamina, flat like the ordinary wing-scale, terminating distally

in a row of processes, probably tubular, which may be called the *fimbriae*, and furnished at its proximal extremity with a hollow prolongation or footstalk, connecting it with an accessory disc which articulates with a socket in the membrane of the wing. This form of scale is often comparatively ill-provided with pigment. It occurs under various modifications in nearly every Pierine genus, the exceptions being the *Dismorphia* group and *Leptosia*; *Colias* with its allied genera, such as *Catopsilia*, *Gonepteryx* and *Terias*; and in addition to these the genera *Prioneris*, *Elodina*, *Metaporia*, *Baltia*, *Phulia*, and *Eucheira*. It is confined to the upper surface of the wings, and to individuals of the male sex. The fact, recognised by Fritz Müller in 1878, that the occurrence of these scales very frequently coincides with the presence of a distinct perfume is strong evidence of their general function as a scent-distributing apparatus, though it is to be observed on the one hand that a characteristic odour may be developed in their absence, and on the other, that they may be present in large numbers without giving rise to any perfume recognisable by the ordinary human perception. It is certain that, in some cases at all events, a scraping of scales from the upper surface of the fresh wing of a male Pierinè will emit the characteristic odour of the species, provided that plumules be included; a similar scraping from the underside of the male, or from either surface of the female wing giving a negative result. Any one can easily verify this for himself, as was first pointed out by Weismann, by applying a clean camel-hair brush to a freshly-caught specimen of the "green-veined white" (*Ganoris napi*). It may be remembered that I have shown the possibility of extracting the perfume from the wings containing these scales by steeping them in alcohol. In a series of these alcoholic extracts, which were exhibited at a meeting of this Society, the species from which the preparations were made could be easily recognised by the scent of the extracts alone.

In view of these facts there is little room to doubt that under ordinary circumstances a certain amount of perfume attaches to the plumules themselves, though from their purely chitinous structure it cannot be supposed that they are in any way concerned in its production. This latter is no doubt the

function of specialised cells embedded in the hypodermis of the wing. Cells of this kind, noticed by Weismann in 1878, have been described and figured by Günther under the name of "Drüsenzelle" or "gland-cells," though so far as I am aware they have not yet been observed in direct connection with the plume-scales. The odoriferous secretion, which is possibly of the nature of a volatile oil, must pass in the first instance into the basal disc; thence along the footstalk, which is undoubtedly tubular, into the interior of the lamina or main portion of the scale; and finally into the outer air by way of the array of fimbriae.

The basal appendage, by which the whole scale articulates with its socket in the membrane of the wing, has by some writers been called the "bulb." But it is certainly in most cases a comparatively flat structure like the lamina itself, and I therefore prefer to speak of it as the basal or accessory "disc," or simply as the "disc" without qualification. It is usually furnished with an internal chitinous structure which in many cases bears the appearance of a convoluted tube. There is also apparent in many instances an aperture, generally proximal, by which I suppose the interior of the disc to be put into communication with the secretory apparatus contained in the wing. Connection between the interior of the disc and that of the lamina is provided by means of the pervious footstalk.

The footstalk often shows a sharp S-shaped bend; but it may, at least in the detached scale, be straight. The portion of the basal area of the lamina immediately adjacent to the insertion of the footstalk is usually clear; and, except for a fan-shaped system of faintly-marked streaks radiating from the point of insertion, is apparently structureless; but at a distance from that point, which varies according to the species, a chitinous structure becomes visible. This occupies the interior of the lamina, and frequently presents a more or less scalariform appearance. A longer or shorter region at the distal end of the lamina is again comparatively clear, often exhibiting a longitudinal striation, which may be faint or distinct. It frequently happens that between this striated area and the portion of the lamina exhibiting the scalariform

structure, there is an intermediate region where the markings become crowded and indistinct, the appearance presented being that of a dense accumulation of granules. This is no doubt chiefly due to the presence of pigment, and is especially well seen in certain species of the genera *Ganoris*, *Pinacopteryx*, *Delias* and *Nepheronia*.

The lamina varies much in shape in different groups. From its distal margin, which is usually pointed, but may be rounded or nearly straight, the fimbriae take their origin. These are usually from twenty to thirty in number, and appear to be in direct connection with the chitinous divisions of the lamina indicated by the longitudinal striation above mentioned. It is not easy to say from actual observation whether their distal extremities are open, though their aspect under a high power suggests this; and it would seem to be necessitated by the view here taken of the function of the plume-scale, that the fimbriae should consist essentially of tubular prolongations of the intra-laminar cavity, provided with terminal orifices. That the lamina itself is permeable to fluids can be easily demonstrated by applying moisture in the form of breath to a glass plate on which some of these structures are displayed. Under a moderate power of the microscope it can be seen that the plume-scale readily fills up by capillary attraction, and it is frequently obvious that the invasion of fluid does not proceed uniformly along the lamina, but follows the longitudinal lines marked out with more or less distinctness by the ribbed or scalariform internal chitinous structure of the scale. As the fluid is apt to run more rapidly along some of these lines than along others, the general line of advance tends to be uneven.

This appearance, it may be noted, is not confined to the plume-scale, but is observable also in wing-scales of the ordinary character.

In view of the structural features that have now been described, the interpretation suggests itself that in the most usual form of plume-scale the greater part of the cavity of the lamina is divided more or less completely into longitudinal channels, with or without lateral communications. These channels arise by divergence from that portion of the base of

the lamina where the footstalk is inserted, this giving rise to the fan-shaped appearance already noted. Leaving the base, the channels run more or less parallel with one another towards the distal margin, passing on into the fimbriae, and finally debouching into the atmosphere by means of the terminal orifices of those structures. This may be considered the normal arrangement, but it is liable to considerable modification in certain groups.

The articulation of the plume-scale with its socket in the wing-membrane has been spoken of by some writers as a ball-and-socket joint. This is incorrect; for, as has been seen, the articulating portion of the scale is not a ball or globule, but a flattened disc. The socket for the reception of the disc is usually easily distinguishable from the sockets for the attachment of the ordinary wing-scales by its superior size and by certain other features. The shape of the socket is more or less adapted in conformity with that of the corresponding disc; it does not, however, receive the whole of that structure; a portion, which may be the larger, being left outside the socket.

The distribution of the plume-scales on the surface of the wing is liable to great variation as between different groups. In some instances they are scattered at regular intervals over the greater part of the upper surface of both fore- and hind-wing. In others they are confined to certain areas, within which they may be so numerous as to produce an appearance easily recognisable by the naked eye. But these accumulations of plume-scales in the Pierinae seldom, if ever, become so conspicuous as the "sexual brands" seen for example in *Amauris* or *Euploea*. The scales composing the brands in *Dismorphia* and in certain species of *Colias*, *Terias*, *Catopsilia* and some allied genera are of a different character from the plume-scales. As I hope to deal with these Pierine brands on a future occasion, I will here only remark that they are commonly, though not invariably, so placed as to be closely covered up during rest, often as by a sliding lid. This is no doubt for the purpose of economising the perfume; and it may also here be mentioned that in several of these cases I have detected a special supply of tracheal branches distributed to the brand or scent-patch, suggesting a means by which, when the covering

structure is removed, the escape and evaporation of the odoriferous substance may be assisted. My observations do not enable me to explain the exact mechanism of this process, supposing it to take place. But the special distribution of tracheae to these patches is a fact which can be verified without difficulty, though I believe it is now noticed for the first time.

The plume-scales, on the other hand, even when collected into more or less definite patches, are seldom provided with a cover. The conjecture may be hazarded that their insertion among other scales, usually larger and longer than themselves, may prevent a too rapid dispersal of their odour; it may also perhaps be the case that the disc so often possessed by the plume-scales, but invariably absent from scent-scales of the other type, may act as a reservoir; the scent escaping a little at a time through the comparatively narrow footstalk. The sharp bend so often to be seen in the course of the footstalk may impede the passage of the scent under ordinary circumstances, and if we may proceed a little further along the path of conjecture, we may venture on the hypothesis that the peculiar fluttering about the female, which is a noticeable feature in the courtship of some Pierines, may have the effect of causing a certain erection of the scales, with a consequent straightening of the footstalk, and more plentiful liberation of the perfume. After this digression into the realms of guess-work we will return to the region of sober fact.

When definite "brands" are present, they are, of course, available as an aid in distinguishing the sexes; they have, in fact, long been so employed. But I think it has not been noticed, or at any rate recorded, that in very many instances among the Pierines, even where the plume-scales are scattered over the general surface and are not collected into definite areas, their presence imparts such a peculiar roughened character to the texture of the wing as seen with the naked eye, that the sexes can be distinguished at a glance by this feature alone, without recourse to any other means of recognition.

It was suggested many years ago that the characters of wing-scales might be used for purposes of diagnosis. The suggestion was dismissed by the late Professor Westwood

on the ground that scales of many diverse forms could be found in the same individual. This, of course, is perfectly true; nevertheless the suggestion is not entirely unworthy of notice. There are probably few cases, if any, where a specific diagnosis can be made from the ordinary wing-scales. But it is occasionally possible on an inspection of these structures to pronounce with some confidence on the genus of their possessor. The long spatulate scales of the genus *Pinacopteryx*, for example, can scarcely be mistaken, and the short, rounded scales of *Baltia* and *Phulia* are characteristic.

When, however, the plume-scales are examined, the case is seen to be entirely different. These, speaking generally, are fairly constant within the limits of a species, and often present distinct specific features. Still more striking are the characters exhibited by them which may be called generic. Though there are some remarkable exceptions, it would on the whole be true to say that most of the genera now usually recognised could be defined on the structure of their plume-scales; a circumstance which is satisfactory as tending to show that our Pierine genera are for the most part natural groups. No one who had once seen the plume-scale of any African species of *Mylothris* could ever take it for anything else, nor could he fail to recognise the genus of any other African *Mylothris* whose plume-scale he might meet with afterwards. In this connection it is interesting to observe that the plume-scales of the American species *pyrrha*, *malenka*, *lypera* and *lorena* are of an entirely different type from the African species with which they have been supposed to be congeneric. This is so far confirmatory of the opinion expressed by me many years ago, in agreement with Mr. Trimen, that the affinities of these American species must be sought in another direction; any resemblance between them and the African *Mylothris* being merely superficial. I shall have more to say on this point presently.

There is sometimes a kind of rough relation between the ordinary scales and the plume-scales in the matter of size. The ordinary scales differ much in dimensions, particularly in length, between different species. Elongated plume-scales are frequently found in relation with elongated scales of the

common type. But this is not invariably the case ; it sometimes happens that the plume-scales are conspicuously shorter than the other scales amidst which they are embedded.

Having now briefly discussed the usual appearance and characteristic features of these structures, I propose in the next place to give some account of the various forms assumed by them in the different Pierine genera ; noting incidentally any marked exceptions to the general statements advanced above. For the sake of uniformity I employ the generic names adopted by Dr. Butler in his arrangement of the Pierinae in the National Collection ; these having also been used by me in a paper on Pierine Phylogeny in our "Transactions" of 1894. A few of his identifications have been altered in accordance with the present arrangement in the British Museum.

The Indian and Malayan genus *Ixias* consists of white or yellow butterflies with an orange tip which may be absent in the female. All the species are provided with plume-scales, which with one exception bear a strong family likeness to one another. The exception is *Ixias marianne*, one of the white species, in which the lamina is sharply triangular. In the other forms of *Ixias* the lamina is rather long and narrow, slightly compressed laterally, and somewhat expanded at the base, which tends to be bilobed. *Ixias nola*, the other white species, has a plume-scale which bears a greater resemblance to the yellow forms than to *I. marianne*, though it approaches the latter in the sharpness of its apex. In all the species the disc is moderate in size, oval or circular.

The large orange-tipped butterflies belonging to the genus *Hebomoia* are furnished with plume-scales which are not unlike those of *Ixias*, though much larger. The lamina is long, narrow, and laterally compressed, with an acute apex and rounded base. The footstalk shows a sharp curve ; the disc, moderate in size, is often depressed in the middle, thus becoming concavo-convex or ladle-shaped. The appearances presented by the fimbriae are a little difficult to interpret. Some of them seem to be bifid, especially those towards the base of the apical triangle. Frequently they appear to end in sharp-pointed hooks, which on a change of focus are replaced by well-defined circular dots giving the idea of terminal

orifices. Occasionally they look as if they were enlarged at the distal extremity, but so far as I have been able to observe, this is never actually the case; the appearance resulting either from imperfect focussing or from a twist in a fimbria which is flattened rather than strictly cylindrical. These appearances are specially well-marked in *Hebomoia*, but are also observable in many other genera with greater or less distinctness.

One of the most interesting of Pierine groups is the genus *Teracolus*. This large assemblage falls naturally into subordinate sections, two of which, under the names of *Idmais* and *Callosune*, have occasionally been considered to be worthy of generic rank. These divisions correspond to a great extent with differences in the scent-distributing apparatus. Thus, in the *Idmais* group there are no plumules; *T. fausta*, *T. puellaris*, and the species allied to them being provided instead of plumules with specialised scales of another type, collected into definite "sex-brands."

The plume-scales of the African purple and maroon-tips, *T. phleggyas*, *T. ione*, *T. regina*, *T. hetaera*, and *T. ludoviciae*, are remarkable for the great size of the disc. In other respects they resemble the *Ixias* type, though generally smaller, and with a sharper apex. Scales with discs of very much the same appearance are found in *T. mananhari* and *T. elgonensis*, also in the little group of desert forms constituted by *T. halimede*, *T. heliocarustus* and *T. pleione*. The disc in all these is a very remarkable structure, but still more curious is the form that it assumes in *T. chrysonome* and *T. protomedia*. In these species we find in place of the usual rounded disc a large semi-transparent plate, generally oval or shuttle-shaped, with the axis transverse to the axis of the lamina, and exceeding the breadth of the lamina in measurement. This basal plate has a marginal thickening of chitin, which in *T. protomedia* is beaded. In both cases fine chitinous lines are seen radiating from the centre of the plate. The attachment of the footstalk, as in other cases, is marginal. In taking specimens of these scales, the plates are very apt to become detached; and when I first examined a preparation made from *T. protomedia*, I was for awhile puzzled by the numerous fusiform objects, like delicate silver

fligree basket-work, that were scattered over the slide. In appearance they were so dissimilar from the ordinary disc that their real nature did not suggest itself to me; and it was some time before I discovered, from the accidental occurrence of a lamina with the plate still attached, that they were homologous with the well-known accessory discs of other Pierine plume-scales.

In the crimson-tipped group, *T. annae*, *eupompe*, *dulcis* and *danae*, the disc is moderate-sized or small, contrasting in a marked manner with the corresponding structure in the purple-tips. The shape of the lamina may be described as ovoid with a sharp apex. The base tends to be squared; in *T. eupompe* the lamina is cordate. *T. annae* stands somewhat apart from the rest of the group by the breadth of its lamina in proportion to its length. The sides are parallel and the apex less acute. The scale in *T. danae* is markedly smaller than in the other crimson-tips.

The plume-scales in *T. ephyia* and *T. etrida* are still smaller than those in *T. danae*, but are of similar general character. In a group composed of *T. evippe*, *omphale*, *achine*, *evanthe* and *luis* the disc is large and the footstalk often straight. Together with a strong family resemblance there are minor points of specific difference. *T. antigone* presents a broader scale, with a squared instead of a rounded base. The scale appears to be longer and narrower in the wet-season form than in the dry. *T. niveus* has a scale of the same character; in both of these species the disc is large. It is a curious fact that neither in *T. auxo* nor in *T. incretus* have I been able to discover any plume-scale or corresponding structure; nevertheless, I know from my own observation that *T. auxo* has a distinct and fragrant odour. Both *T. evarne* and *T. phillipsi*, which appear to be nearly related to the species just mentioned, possess plume-scales with small discs, and seemingly scanty in number. It is worth remarking that in *T. incretus*, *phillipsi* and *evenina* many of the orange-pigmented scales of the ordinary kind show a lateral curvature. These curved scales have a rounded distal extremity, with no processes. In *T. subfasciatus* the plume-scale is long, narrow and laterally compressed, as in *Ixias*. The disc is small. A still longer and narrower scale,

with an equally small disc, is that of *T. eris*; the footstalk also in this species is unusually long. *T. agoye*, a noteworthy species in other respects, has a remarkable plume-scale. The lamina is long and narrow with an expanded and rounded base. The disc is large, and in preparations appears to be set at right angles to the lamina. The fimbriae are few—not more than twelve, which is about half the usual number. Ordinary scales with orange pigment, process-less like those of *T. evenina*, etc., occur in *T. agoye*; but no lateral curvature has been detected in them hitherto.

The plume-scale of *Herpaenia eriphia*, as might be expected, is like that of a *Teracolus*. It may be described as a somewhat shortened and thickened version of that of *T. eris*. The footstalk is long, as in that species.

We now come to the genus, or group of genera, known as *Eronia*. With respect to this assemblage it is interesting to observe that its sub-division into *Nepheronia*, *Leuceronia* and *Eronia* proper, which was made on other characters, is entirely borne out by differences in the plume-scales. It would be quite easy to determine from a single specimen of these scales to which of the three genera its possessor belonged, and in many cases it would be possible to pronounce at once upon the species. In *Nepheronia*, which is entirely Eastern in distribution, the plume-scale is characteristically long and narrow, with an extremely sharp apex. In a few species the breadth of the lamina is uniform; in others the lamina tapers more or less gradually from base to apex. In most the base is rounded, in one or two it tends to be squared; in the Moluccan form *N. argolis* it is ogee-shaped. A curious feature in several of the species is a clear area occupying the breadth of the lamina, a little proximal to the apex. Both distally and proximally to this area the lamina is densely granular, giving the appearance of pigmentation. The disc is usually small, in some species very small; but in *N. phocaea* and one or two other of the island forms it is comparatively large. A circular mark is often apparent, which may be the usual proximal orifice of the disc, or may possibly denote the insertion of the footstalk.

A remarkable fact about the scent-scales in *Nepheronia* is

their mode of distribution on the surface of the wing. Though they may, at any rate in some species, be found sparingly on the general surface, they are much more numerous in a certain circumscribed area along the border of the hind-wing; in one or two species they appear to be confined to the costal extremity of this area. Along this marginal region they occur in such abundance as to cause a marked difference in the texture of the wing, making their presence plainly visible to the naked eye, and almost deserving the appellation of a "sex-brand." Mixed with them are found in great abundance scales of a different kind; these are elongated, of the shape of an Indian club, not distally indented, very heavily loaded with dark pigment, and showing especially dark longitudinal streaks. The ordinary scales from the blue portions of the wing are curiously sculptured and apparently unpigmented.

Nepheronia avatar differs somewhat from its congeners. Its scent-scales are distributed over the general surface of the wing; they are much smaller than in other *Nepheronias*, and have a correspondingly small disc.

The species of *Leuceronia* are exclusively African. In this, as in the preceding genus, we find the scent-scales densely congregated within definite areas, not, however, to the entire exclusion of other parts of the wing. On a careful examination of the wing-surface in *L. thalassina*, *argia*, *pharis* and *buquetii*, a slight depression or pucker will be seen at the end of the cell of the hind-wing. This depression is usually visible in both sexes; in the male it marks the situation where the plume-scales are most certainly to be found. It is a very curious fact that, so far as my observations extend, the plume-scales in *Leuceronia argia* from Natal and S. Rhodesia (*L. varia* of Trimen) are confined to this situation; whereas in specimens from the West Coast, the Kassai region of the Congo, the River Lualaba, and British E. Africa, they are to be found plentifully distributed over the general surface.

In *L. thalassina* the lamina is somewhat long and thin, with parallel sides and an expanded and rounded base. The whole scale is curiously glassy and translucent; it appears to be entirely devoid of pigment. In *L. argia* the lamina is longer;

the base is still more expanded, and ends in curved lateral processes or cornua, which are more strongly marked in the Western than in the Southern forms, reaching in a specimen from Ashanti a development which approaches that of the next species, *L. pharis*. This last-named butterfly, noteworthy for its superficial resemblance to *Nychitona medusa*, possesses a highly remarkable scent-scale. The lamina is very long, very narrow, and exhibits a greatly expanded and strongly cornuated base, which may be called "half-moon shaped." A collection of these scales examined with a low power reminds one forcibly of a cuneiform inscription thrown into confusion—a kind of "printer's pie."

But perhaps the strangest form of scent-scale to be found in this genus is that of *L. buquetii*, which is very large, of nearly uniform breadth, but slightly narrower towards the greatly blunted apex. The basal corners are slightly rounded, but the whole aspect of the lamina is quadrangular. The chitinous ribbing is very pronounced; a slightly altered arrangement along the central axis produces the effect of a core for about the basal two-thirds of the scale. The fimbriae are unusually short. In all these species of *Leuceronia* the disc is large; extremely so in *L. buquetii*, least so in *L. thalassina*. In *L. argia*, and to a less extent in *L. pharis*, some of the ordinary scales have sharp basal prolongations, giving them, with the footstalk, a three-pronged appearance. It is observable that, as probably would have been guessed from their general appearance, the species of the last two groups that come nearest to each other in respect of their scent-scales are *Nepheronia avatar* on the one hand, and *Leuceronia thalassina* on the other. *L. buquetii* seems to be the most divergent.

The two species of *Eronia* proper, viz. *E. cleodora* and *E. leda*, present a different kind of plume-scale from the preceding. In *E. cleodora* the lamina varies somewhat in breadth, but is always U-shaped, with parallel sides and rounded base. The fimbriae are rather short and tend to be wavy; they may apparently be bifid, and may anastomose. In *Eronia leda* the lamina narrows gradually from base to apex; the base is provided with lateral cornua more or less

pronounced, and the fimbriae, like those of *E. cleodora*, are wavy. The disc in both these species is remarkably small, contrasting strongly with that in the two preceding groups. Another point of difference is that in *Eronia* proper the scent-scales seem to be generally distributed, and not gathered into definite spots.

In Madagascar there occurs a curious form, "*Ptychopteryx*" *lucasi*, the affinities of which are doubtful, though on the whole it seems more nearly allied to the *Eronia* group than to any other assemblage of Pierines. Its plume-scales, which are very numerous, do not give much help towards determining its position, for they may be said to be unique. The lamina is somewhat slug-shaped, expanding proximally. The apex is blunt and the fimbriae short. The base ends in two thin, sharp-pointed cornua, inclined towards one another in the form of a V; the points sometimes meet one another, sometimes overlap. Between them the footstalk passes to a large, clear, nearly circular disc. The scale by its general outline, its blunt apex, short fimbriae and unusually large disc, shows points of resemblance to that of *Leuceronia buquetii*; the latter, however, gives no indication of the sharp-pointed, introverted basal cornua which form one of the strangest features of this remarkable structure. The ordinary scales are frequently spatulate, in which respect they bear some resemblance to those of the African genus *Pinacopteryx*, but this correspondence, such as it is, is not borne out by other characters of the two genera.

We come next to *Euchloe*, the genus of the Palearctic and American orange-tips. In some species the plume-scales appear to be entirely absent; I have found none, for example, in *E. scolymus*, *E. sara*, and *E. euphenoides*. In *E. genutia*, *E. pima*, and *E. eupheno* they are scanty; *E. cardamines* and *E. ausonia* have them in fair numbers, while in *E. creusa*, *E. bellezina* and *E. belemia* they are abundant. The scent-scales of most of the species that possess them resemble each other in general character. A marked feature that they have in common is the small size of the accessory disc; this is especially noticeable in *E. cardamines* and *E. belemia*. In some species the sides of the lamina are parallel or nearly so,

in others they are laterally compressed and diverge distally, in which case the lamina assumes a trumpet-shaped, or rather perhap a goblet-shaped appearance. This is best seen in *Euchloe creusa*; it is also liable to occur in *E. bellezina* and *E. belemia*. The apex is often blunt and rounded; this is especially visible in *E. creusa*; somewhat less so in *E. pima*, *genutia* and *cardamines*. The base is usually rounded, but may be noticeably squared, as in *E. pima*.

The scent-scales in *Euchloe eupheno* are peculiar. The lamina is long and narrow with a very slight bilateral compression. The rounded apex is extremely blunt, and the base is tapering. The fimbriae are short, about 12 in number, and seem to be continued into the scale as chitinous bars; there is no distinct line of demarcation between fimbriae and lamina. The foot-stalk is narrow; the disc appears to be represented by a small ladle-shaped dilatation close to the proximal end of the foot-stalk, the actual termination of the latter being visible as a slight projection from the disc. The conjecture may be hazarded that this is a comparatively early and unspecialised form of plume-scale, presenting points of resemblance to certain hair-scales that occur in other Pierine groups where plume-scales are not developed. Unique within the genus as at first sight it appears to be, in its blunt apex, tapering base and minute disc it is not greatly dissimilar from the corresponding scale in *E. creusa*. I have indeed on one occasion obtained from the latter species a long, trumpet-shaped scale which came very near that of *E. eupheno*. It is, however, just possible that this scale may not have really belonged to the specimen. Why *E. euphenoides*, which so closely resembles *E. eupheno*, should be apparently devoid altogether of these structures it is hard to say; but there are several parallel instances.

Zegris is perhaps scarcely worth separating from *Euchloe*. In *Z. eupheme* I find no scent-scales, unless certain Indian-club shaped, pigmented scales, without either disc or fimbriae, are to be taken as such. *Z. olympia* has a scale of the *Euchloe* pattern, with parallel sides, squared base and small disc. The lamina is proportionately broad, and the fimbriae are short.

The plume-scale of the remarkable Chilian orange-tip,

Eroessa chilensis, belongs by its goblet-shaped lamina, with rounded base and minute disc, to the *Euchloe* type. It is perhaps most like the plume-scale of *Euchloe creusa*, but is much larger than that of any *Euchloe* known to me.

The South American genus *Hesperocharis* is provided with plume-scales which also in some respects resemble those of *Euchloe*. The laminae are U-shaped, with parallel sides and a rounded base. The disc is small, in some species tending to be triangular. The laminae show, however, little indication of the goblet form seen in *Eroessa* and some species of *Euchloe*, and they further differ from most species of the latter genus in having a very sharp apex, which contrasts strongly with the blunt and rounded distal margin seen in *Euchloe genutia*, *pima*, *cardamines*, *creusa*, *bellezina* and *eupheno*. They are usually broad in proportion to their length, and vary in size from species to species, *H. marchalii* and *H. erota* marking the extremes among the species known to me, the former being the largest. *Mathania agasicles*, so far as its scent-scales are concerned, is a *Hesperocharis*.

Daptonura, another South American genus, suggests by its neururation and some other features a relationship with *Belenois*. This suggestion, however, is not borne out by an examination of the plume-scales. These in *Daptonura* are of an entirely different type from that of *Belenois*, and indeed of nearly every other genus of Pierines. They are abundant in all forms of *Daptonura*, and are of the same character throughout the genus, showing but little difference from species to species. They are more like hairs than scales, being long and narrow, generally club-shaped, and possessing no disc. They taper gradually from the distal extremity towards the base, which ends in a footstalk like that of an ordinary scale. The distal extremity may be either (1) rounded, (2) truncate or slightly excavated, or (3) two-lobed. The fimbriae are few and very short; in no case are they found at the centre of the distal margin, but project only from its sides, occasionally from one side alone. The rounded end in (1), the truncated border or slight concavity of (2) and the inter-lobular notch of (3) are always free from them. No connection is traceable between the fimbriae and the chitinous framework of the scale. In

D. leucanthe and *D. lycimnia* the fimbriae seem sometimes to be connected inferiorly with the body of the scale by a transparent triangular membrane. This recalls an appearance occasionally to be seen in veritable hair-scales, which structures the present scales also frequently resemble in being rather heavily charged with pigment. That these curious organs are really scent-scales is made probable by the fact that they are confined to the male sex; but they differ from every other kind of plume-scale known to me in being found on the under as well as the upper side of the wing of their possessor. In this respect they conform to the condition that is often seen in scales that are congregated into definite sexual brands or patches, but is never to be observed, so far as I am aware, in the normal plume-scale.

The African genus *Pinacopteryx* forms a very natural assemblage; in its neurulation resembling *Belenois*, but differing widely from that genus in respect of its plume-scales. These are characterised by the expanded, usually rounded bases of their laminae. In the West Coast species *Pinacopteryx cebroë* and *P. falkensteinii*, especially in the former, the lamina is long and tapering and the base angulated. In *P. falkensteinii* the disc is unusually large. The plume-scale of *P. dixeyi* from Toro is like that of *P. falkensteinii*, except that the disc is very much smaller. The forms grouped together as *P. pigea* and *P. astarte*, including Mr. Neave's striking series from N.E. Rhodesia and the Congo, exhibit the same general character of a long, narrow, tapering lamina with a more or less expanded and rounded base, and moderate-sized disc. In *P. orbona* from the West Coast, and a specimen from Toro which is probably to be identified with *P. rubrobasalis*, the base, still rounded, is less expanded, and the lamina less tapering. *P. vidua* has a distinctive scale somewhat of the *pigea* type, but much shorter and rather broader in proportion. The scent-scale in *P. spilleri* is also of the *pigea* type, but with a more expanded base, which shows a tendency to angulation. These structures do not share in the yellow pigmentation of the ordinary scales of this species. A well-defined section of *Pinacopteryx* is formed by *P. doxo*, *P. simana*, *P. charina* and *P. liliana*. The base in these forms is expanded, as in all

other species of the genus, but the expansion is abrupt and the sides of the lamina distal to it are parallel. The shape suggested by the lamina in the first three species is that of a chemist's combustion-tube, short and broad in *P. doxo*, longer and narrower in the other two. The plume-scale of *P. liliana* is quite distinctive, and one of the most curious known to me. The basal expansion is very large and well-rounded, the base itself being usually flattened. The appearance suggested by the outline of the lamina is that of the thin glass flasks used in chemical laboratories. The long axis of the lamina, however, is not straight, but obtuse-angled. This gives the neck of the flask a decided list. At the junction of the neck with the body of the flask is a very conspicuous granular area, oval in shape, dark by transmitted light, and showing a comparatively transparent, roughly circular patch in the middle. The apex of the lamina is sharp. The disc is large, figure-of-eight shaped, and exhibits a clear, round or oval area, which appears to mark the point of attachment of the footstalk. The latter is sharply bent. A small bright point which is usually visible in connection with the clear discal area just mentioned may be an orifice, or may possibly indicate the actual termination of the footstalk. The ordinary scales in *Pinacopteryx* are very frequently spatulate.

The next genus, *Belenois*, has its metropolis in Africa, but outlying forms occur in Southern Asia, the Malayan Islands, and even as far eastward as Fiji. One species stands quite apart from the rest in virtue of the very remarkable character of its plume-scale, which may really be called unique. This is *Belenois gidica*. The lamina in this species is slug-shaped, somewhat broader towards the base. The distal and proximal borders are both rounded, the former more so than the latter. The fimbriae appear to be represented by four or five minute tubercles on the distal border or apex; the footstalk is long, and the disc, in marked contrast to the rest of the genus, very small. The lamina shows a curious sculpturing, looking like a series of short grooves arranged in longitudinal rows. These may possibly be orifices, compensating for the apparent absence of fimbriae; their appearance is somewhat suggestive of the markings on the "battledore scales" of *Lycaenids*.

Another very remarkable scent-scale is that of the Madagascar species, *Belenois antsianaka*. This is very large; the lamina is somewhat hastate, the sides being convex near the expanded base, concave near the apex. The base shows a tendency towards cornuation, the apex is sharp. The axis of the lamina is occupied by a "core," a mesial streak of the same translucence as the bulk of the scale, with an opaque granular streak on each side of it. At the base of the apical triangle the translucent streak disappears, and the lateral streaks become merged in an opaque granular round or oval mass occupying about half the breadth of the scale at this situation. The chitinous ribbing of the lamina is very prominent; it somewhat resembles the condition obtaining in *Mylothris*. The fimbriae are slightly waved near their attachment. The disc is large; it is chestnut-shaped, and looks dark under transmitted light.

A scale of somewhat similar character, but much smaller, and without the central "core," is met with in *Belenois ianthe* from the West Coast, and *B. solilucis* from the Nyanza region. Modifications of the same type occur in *B. helcida*, *B. hedyle*, *B. calypso* and *B. dentigera*. In these the lateral compression, though present, is much less evident; the chitinous ribbing is in *B. hedyle* especially well-defined, and the lamina in this and some other species tends to be curved about the vertical axis like the blade of a gardener's trowel. The fimbriae in *B. hedyle*, *B. ianthe* and *B. solilucis* have an S-shaped curve, which may be compared to that of a swan's neck. In *B. calypso* they appear as if arising from a fenestrated border instead of an entire margin. The lamina in *B. thysa* is rather long in proportion to its breadth, and the sides are parallel.

The scent-scales of *B. grandidieri* and *B. zochalia* are smaller than the preceding, but otherwise not dissimilar. The lamina in the latter species is often slightly unsymmetrical. In *Belenois severina* the sides of the lamina are nearly parallel and the base somewhat angular. The apex is sharper in specimens from the West Coast than in those from East Africa. In Indian specimens of *B. mesentina* the lamina is broad and the apex acute; African specimens generally have the lamina longer and narrower. The plume-scales of *B. java*,

B. teutonia and *B. peristhene* are of the *mesentina* type, those of *B. clarissa* tend to be laterally compressed and somewhat tapering. The disc in all species of *Belenois* except *B. gidica* is large, chestnut-shaped and opaque by transmitted light. It is apparently filled with a closely-packed convoluted chitinous tube.

No plume-scales are discoverable in the genus *Prioneris*. This was noticed many years ago by Watson, and is commented on by Wallace in his valuable paper on the Eastern Pierinae.

In the great Oriental and Australian genus *Delias* we come to an entirely different kind of scent-scale from those already dealt with. The lamina is usually large, and more or less tapering towards the distal extremity. The base is generally rounded, and the apex filiform, having, with the fimbriae, a really plume-like appearance. The sculpturing of the lamina with a moderately high power looks granular; in several species, notably *D. harpalyce*, *D. gabia* and *D. agostina*, the granular arrangement is modified along the course of the axis, giving the idea of a central core. This may be well-defined, as in the first of the species named, or diffused as in *D. aganippe*. The lamina may be called kite-shaped in *D. pyramus*, *D. ninus*, *D. egialea* and other members of the *pyramus* group; pyriform in *D. agostina*; tadpole-shaped in *D. belladonna*. In the *belisama* section the lamina resembles an Indian club reversed; that of *D. indistincta*, from its nearly squared base, is like an elongated champagne-bottle; and similar contours are shown by *D. nysa*, *D. momea*, the *aganippe* and *isse* groups. The scent-scales in these species are mostly very long, in correspondence with the ordinary scales of the wing. They are often abundant, occasionally even seeming to outnumber the ordinary scales, and in common with these latter are, as a rule, easily detached. The disc is usually large, frequently kidney-shaped, and often with the internal chitinous structure especially well-marked. In *D. momea* it is exceptionally small; in *D. aruna* it is cocked-hat shaped. In the *pyramus* group there is generally a sharpish median proximal projection. The scales are long in the *belisama* and *aganippe*, comparatively short in the *isse* assemblage. The *pyramus* section in this respect is intermediate.

There is an important group of *Delias*, consisting of *D. mysis*, *D. argenthona*, *D. caeneus*, and *D. eucharis* with the geographical forms *D. stollii*, *hierte* and *hyparete*, which is marked off from the rest of the genus no less by the character of its plume-scales than by its obvious aspect. The laminae in these species possess the common character of a triangle with elongated apex, so that their outline may be compared to that of an inverted funnel or trumpet. In *D. argenthona* and *D. hyparete*, the lamina, from its expanded and rounded base, may perhaps more aptly be termed decanter-shaped. The apex in these species, though narrow, is blunt, and not filiform as in the majority of the species of *Delias*. It is often laterally bent, and may be slightly twisted. The fimbriae, which are rather short, are termino-lateral. The scent-scales in all this group are very much smaller than those of most other members of the genus; the discs are large in proportion, generally rounded, and in some species, notably *D. caeneus*, well-displayed in consequence of the straightness of the footstalk.

As regards their scent-scales, *Delias nigrina* and *D. ornytion* are in some ways transitional between the *eucharis* group and the rest of the genus. Like the former, they have a triangular lamina with a prolonged apex; this, however, is acute though not filiform. The lamina is much larger than in the *eucharis* section, but still below the average size of the genus. A curious feature in *D. ornytion* is the frequent presence, on one lobe only of the somewhat cordate base, of a sharp spur looking like a rudimentary form of such a spine as occurs in "*Ptychopteryx*" *lucasii*.

It is perhaps worth noticing that when I was investigating the genus *Delias* from the point of view of colour-patterns, I was inclined to consider *D. nigrina* as a term in the series leading through *D. harpalyce* up to *D. aganippe*. The evidence of the scent-scales, without contradicting this, seems to indicate an approach on the part of *D. nigrina* to the *eucharis* group, as well as to that with which I formerly associated it; and seems also to show that its affinity with *D. ornytion* is closer still.

Next on our list comes the neotropical genus *Pereute*. The

scent-scales of this assemblage are very remarkable. There is a strong family resemblance between them, though the species are easily distinguished. The plume-scale of *Pereute charops* is a fair representative of the genus. The sides of the lamina in this species are parallel or with a very slight lateral compression, expanding somewhat towards the base. The apex is blunt and the fimbriae narrow. The most curious feature in the scale is the prolongation of the base into two long tapering cornua, which are often bent like a pair of mammalian hind-legs. The long, narrow lamina with its cornuated base strongly suggests the egg-case of a skate, commonly known as the "mermaid's purse."

The plume-scale of *Pereute swainsonii* is very like that of *P. charops*, but the basal processes or cornua are still longer and as a rule more wavy and divergent. The scale in *P. callinice* has the same general character, but the lamina is broader at the base and the apical region is comparatively narrow. The apex itself is blunt, and occasionally twisted. In *Pereute leucodrosime* the base is still broader and the lamina tapers more gradually. In other respects there is a close resemblance to *P. callinice*.

It is curious that *P. antodyca*, which is superficially so much like *P. swainsonii*, has a very different kind of scent-scale. The lamina is ovoidal, broader towards the base. The chitinous framework is very distinct, somewhat like that to be found in the genus *Mylothris*. The apex is blunt; the fimbriae short, often wavy or twisted. The base, instead of being furnished with long tapering processes as in *P. swainsonii* and other species of the genus, is prolonged into short cornua shaped like claws or talons. In *Pereute callinira* we get a form intermediate between *P. antodyca* and *P. callinice*; the laminae, which vary somewhat both in length and breadth, have sides more nearly parallel than in *P. callinice*, but still showing a distinct basal expansion. A curious point in this species is the almost invariable asymmetry of the cornua, one being short and claw-shaped, the other generally longer and often angulated, as commonly in *P. swainsonii*. This species also possesses peculiar scales shaped like an Indian club.

The disc in *Pereute* is moderate in size, that of *P. antodyca*

being the largest. Its form varies somewhat according to the species. The footstalk is uniformly narrow.

Leodonta, which resembles *Pereute* in neuration, presents us with scent-scales of a similar type to those of that genus. The laminae are, however, shorter, and also broader in proportion. The base is cornuated, but the basal processes are generally less elongated than in the preceding genus. The base is usually asymmetrical, as in *Pereute callinira*. This is least marked in *L. zenobia*, but even in this species one cornu tends to be blunt and the other sharp. The footstalk in *Leodonta* is thin and the disc moderate in size; both of which features are also characteristic of *Pereute*.

Still keeping to the Neotropical Region, we come next to the extensive genus *Catasticta*. Here again, together with specific differences, we meet with considerable family resemblance. The lamina in *C. coreyra*, *C. pieridoides* and *C. toca* resembles that of *Leodonta* in having the base more or less asymmetrically cornuated. In the two former species the likeness to *Leodonta zenobia* is increased by the slight convexity of the laminal sides. The genus is characterised throughout by the comparative thickness of the footstalk; this is a point of distinction from both *Leodonta* and *Pereute*. Another characteristic feature, frequent though not universal, is the extreme breadth of the lamina as compared with its length. Among the species known to me, this is best seen in *Catasticta flisa* and *C. bithys*; it is also marked in *C. bryson* and *C. hegemon*. The lamina in the latter is peculiar. In shape it is like a very broad arrow-head, the barbs being represented by short, blunt cornua. The sides are strongly convex, almost angular; the fimbriae, long and straight, are set on about the distal two-thirds of the nearly straight line which runs from the point of greatest convexity up to the apex. There is no angle, such as exists in nearly every other kind of plume-scale, marking the point at which the fimbriae begin. The lamina in *C. colla* is somewhat similar, but less broad and more regularly cordate. In most of the species of *Catasticta* the base is right-angled; it is often slightly bilobed; seldom rounded off, though this occurs in *Catasticta theresa*, *C. manco*, and one or two others. The sides are nearly always

parallel; they may diverge slightly towards the distal margin, as in *C. ctemene*, *C. sisamnus*, *C. semiramis* and *C. chrysolopha*. Rarely they show a slight distal convergence, as in *C. tomyris* and sometimes in *C. coreyra*. The lamina in *C. manco* is heavily pigmented.

Two points with regard to the fimbriae in this genus remain to be noted. In *C. flisa*, and to a somewhat less degree in *C. philone*, these distal structures have a beaded appearance, as if furnished with a row of orifices, or perhaps with a scalariform framework. In *C. coreyra* they are sometimes plainly bifid, but in *C. chrysolopha* they are arranged in groups, each group with a common stem.

It would not, I think, be surprising if the scent-scales in *Euterpe* were like those in the three preceding genera. As a matter of fact they are very different. The lamina in all species of *Euterpe* is long and narrow, the distal border is straight or very slightly convex, the sides taper more or less gradually into a comparatively stout footstalk, which opens proximally into a moderate-sized disc. Slight specific differences are present; in *E. approximata* the sides of the lamina are nearly parallel, in *E. critias* and *E. rosacea* there is slight lateral compression, in *E. tereus* the lamina tapers gradually into the footstalk, the base being scarcely marked. In *E. negrina* the fimbriae are very short, perhaps barely separated; in *E. rosacea* they are longer than in the rest of the genus. There are some indications of an unequal distribution of scent-scales in at least one species of *Euterpe*, viz. *E. critias*, but I have not at present come upon anything in these species deserving to be called a sex-brand.

The plume-scales in *Leptophobia*, another neotropical genus, form a very natural group, chiefly characterised by the minuteness of the accessory disc. This takes throughout the genus the form of a hardly perceptible expansion of the footstalk; a proximal orifice is apparent in some of the species, e. g. *L. semicaesia* and *L. tenuicornis*. In *Leptophobia penthica* the plume-scales appear to be scanty in the white area of the wing, and abundant in the black. This may also be the case with other species of the genus. The laminae are rather long in proportion to their breadth, though much less

so than in *Euterpe*. The apex is usually rather sharp, especially so in *L. eleone*, *L. tovaria*, *L. semicaesia*, *L. tenuicornis* and *L. caesia*. The sides as a rule are nearly parallel; there is slight lateral compression in *L. eleone*; in *L. aripa* and *L. tovaria* the sides converge slightly towards the apex; in *L. tenuicornis* they diverge slightly towards the base. The fimbriae are fairly long, in *L. penthica* they appear to be unusually broad. The base is well rounded in *L. erinna*, *L. eleone*, *L. semicaesia* and *L. cinerea*; it is slightly cornuolated in *L. tovaria*, *L. penthica* and *L. tenuicornis*. The lamina of *L. caesia* is somewhat exceptional in the genus, a little recalling some of those in *Catantix*. It is triangular, the sides converging towards the apex, which is acute. The base is prolonged into distinct cornua, which may be sharp and almost claw-shaped. The disc, however, is thoroughly characteristic of *Leptophobia*, bearing no resemblance to that of the former genus.

The group of neotropical butterflies to which Dr. Butler restricts the generic name *Pieris*, and which is known to some other authors as *Perrhybris*, falls apart, so far as its scent-scales are concerned, into two very distinct sections. The first of these consists of species allied to *Pieris calydonia*, such as *P. viardi*, *P. locusta* and *P. pylotis*. The second comprises what may be called the *P. buniae* group, including *P. phaloe* and *P. sevata*, as well as one or two forms at present unnamed. In the former division the plume-scales are not unlike those of *Leptophobia*, being moderate in size, with sides more or less parallel. They can, however, be at once distinguished from those of *Leptophobia* by the appearance of the disc, which instead of being represented merely by a slight proximal swelling of the footstalk, is a definite structure generally oval or circular in outline, and attaining in *P. pylotis* considerable relative dimensions. The sides of the lamina converge slightly towards the apex in *Pieris locusta* and *P. apicalis*; in *Pieris tithoreides*, *P. calydonia* and *P. demophile* they show a slight distal divergence. The base is rounded in *P. viardi*, *P. demophile* and *P. calydonia*, squared or angulated in *P. tithoreides*, *P. mandela*, *P. marana* and *P. pylotis*; *P. locusta* and *P. apicalis* possess rudimentary basal cornua. In

P. viardi, *pylotis* and *apicalis* the fimbriae are unusually long. The disc in several of the species has an evident proximal orifice; this in *P. apicalis* is exceptionally distinct, and is furnished with a chitinous rim. Some of the ordinary scales in *P. marana* are peculiar, being shaped somewhat like a green fig, and heavily loaded with pigment.

In *Pieris phileta*, more generally known as *P. monuste*, the scent-scales are numerous. They are much like those of *P. tithoreides* and *P. demophile*, but larger. The base is rounded and somewhat narrowed; the sides diverge towards the apex, which is sharp. The disc is small, triangular, and possesses an evident aperture. The fimbriae are rather long, straight and distinct.

Coming now to what I have called the second section of *Pieris*, we find plume-scales of a very different type from those just described. The laminae are exceedingly long and narrow, with a more or less rounded base. The apex is seldom quite so filamentous as in many species of *Delias*, but the general contour and to a great extent the sculpturing of the lamina is strongly reminiscent of that genus. A well-marked point of difference, however, exists in the disc, which in this section of *Pieris* is extremely small. A conspicuous peculiarity of the assemblage now under notice is the localised distribution of the scent-scales on the surface of the wing. If the male of one of these butterflies, say *P. phaloe* or *P. buniae*, be examined, it will be seen, as has indeed been pointed out by Dr. Butler, that the upper surface of both fore- and hind-wing is divided between a smooth and a mealy or roughened area, the difference of texture between the two being on a naked-eye view very like that which is apparent on the wings of male individuals of the genera *Catopsilia* and *Callidryas*. In these species of *Pieris*, however, the roughened area, instead of constituting a kind of border to the wings, occurs in the form of streaks which follow more or less closely the course of the nervures, ending in a tapering extremity as the margin of the wing is approached or reached. These roughened or mealy streaks, which are easily visible to the naked eye, mark the situations where the plume-scales are to be found. Here these structures, which are very easily detached, are so

abundant as frequently to outnumber the scales of the ordinary kind.

In most if not all of the species of this section, the plume-scales are somewhat variable in size and shape, according to their situation ; but all are very long and narrow. Scent-scales from the forewing of *Pieris phaloe* have the lamina tapering gradually from the base for about three-quarters of the distance from base to apex ; the sides for the last quarter run nearly parallel. The base is rounded, the apex very narrow and acute. The laminae of scales from the hindwing tend to be shorter and broader, but retain the same general character as those from the forewing. In some, the base tends to squareness, and the sides taper uniformly nearly up to the apex. The ordinary scales are also long ; especially those from the forewing. They show what is a very common if not universal character in the subfamily ; viz. that the distal margin tends to be indented in scales from the upper side of the forewing ; smooth in those from the underside of the forewing and both surfaces of the hindwing.

The scales in *P. ausia* are scarcely to be distinguished from those of *P. phaloe* ; in *P. sevata* they are somewhat shorter and smaller. In *P. buniae* again, the plume-scales are extremely abundant, far outnumbering, in their special situation, the ordinary scales of the wing. They resemble the scales in *P. phaloe*, and, like them, vary somewhat according to the part of the wing from which they are taken. They can, however, be distinguished from those of that species by the fact that the laminae taper more gradually from base to apex, not showing an attenuated distal portion with sides almost parallel. A species of *Pieris* from Lower California hitherto undescribed, presents us with the longest plume-scale, except those of two or three species of *Huphina*, that I have ever yet met with. It tapers gradually from base to apex just like the similar structure in *P. buniae*, from which in fact it only differs by its extraordinary length and narrowness. As in other species of this section, the base is rounded and the disc minute. The mealy streaks of the forewing are richly provided with these remarkable scales ; the hindwing, which has no mealy areas, is devoid of them or at least only scantily furnished. The species

which comes nearest to the form just mentioned is apparently *Pieris josepha*. I have been unable to examine the scent-scales of the latter insect, as the specimens at my command are all females. A form of *Pieris*, also undescribed, brought by Dr. G. B. Longstaff from Venezuela, belongs to the present section. Like *P. buniæ* and others, it has conspicuous mealy streaks, well-developed on the forewing, and less extensive on the hind-wing.

Pieris phileta, otherwise *P. monuste*, shows by its scent-scales no resemblance whatever to the last-mentioned section. On the other hand, its affinity with the first section of the genus, as already stated, appears to be very close. The plume-scale, but for its larger size, might almost be taken for that of *P. tithoreides* or *P. demophile*.

We now come to a group of neotropical species, which on account of their similar venation were ranked by Mr. Butler along with the African species *agathina*, *chloris*, etc., in the genus *Mylothris*. As already mentioned, I had for a long time suspected that the evidence of the venation was in this instance deceptive, and that there was no close affinity between "*Mylothris*" *pyrrha*, *malenka*, etc., and the old-world forms with which they had been associated. Mr. Trimen had expressed a similar opinion, though I was not aware of this at the time. From these considerations, the examination of the scent-scales became especially interesting. Their testimony was clear; the scent-scales of the neotropical species mentioned belong to an entirely different type from that of the African genus *Mylothris*. On the other hand, they are by no means unlike the corresponding structures in what I have called the first section of *Pieris*, and in one or two points show a resemblance to *Catasticta*. If we depended on the evidence of the scent-scales alone, we should unhesitatingly rank *pyrrha* and its associated species with *Pieris locusta*, *mandela*, *apicalis* and *demophile*.

The plume-scales in *M. pyrrha* itself are rather scanty. The lamina is somewhat exceptional in being lance-headed, the sides showing a regular curve instead of an angle. The condition is a little like that seen in *Catasticta hegemon* and *C. colla*, but the scale is not nearly so broad as in those species,

The base is squared and the apex sharp. In *M. malenka* also the scent-scales are scanty. They are like those of *M. pyrrha*, but narrower in proportion. The apex is still sharper, and makes a distinct angle with each side of the lamina. The disc, which is somewhat smaller in proportion than that of *M. pyrrha*, has an evident proximal aperture.

In *M. lorena* and *M. lypera* the scent-scales are fairly numerous. They are of the *P. calydonia* and *P. demophile* type. The sides of the lamina in *M. lorena* diverge slightly towards the distal border; the disc is moderate in size, roundish or oval. Among these scales I have found one specimen of a scale presenting a very different appearance. It is large, long and narrow, the proximal two-thirds tapering gradually into a short, wide footstalk, which ends in a small oval disc. The distal border of the lamina is very slightly convex, and the fimbriae are rather short. The scale has very much the appearance of a *Euterpe* plumule, though the lamina is larger and the disc smaller than in any species of that genus known to me. As in all cases of scales unique among their surroundings, the doubt arises as to whether it really belongs to the specimen from which it was taken, or whether it has accidentally found its way there from an extraneous source of origin. *M. lypera* has a scale like that of *M. lorena*, but with the lamina shorter and squarer. The sides are nearly parallel and the fimbriae long and wavy. The scales seem to vary somewhat in breadth. One scale has been observed which is very much larger than the usual form; the sides of the lamina diverge widely from a narrow and somewhat squared base, the distal border is segmental, not angulated, and the fimbriae are much as in the usual form, being long, thick and wavy.

The scent-scales of the African, or true *Mylothris*, are like one another, but like nothing else in the world except perhaps a dice-box or a lady's corset. The lamina in every species shows lateral compression; this is specially well-marked in *M. poppea*, *M. phileris* and *M. agathina*; less so in *M. jacksoni*. The proximal half of the lamina contains about twelve to fourteen prominent chitinous ribs, roughly parallel, and connected laterally with one another by cross-pieces, the whole

forming an irregular reticulum. The central ribs, generally to the number of six, are prolonged through the median constriction of the lamina into the distal portion, where they diverge, afterwards converging slightly towards the distal extremity of the lamina. These chitinous ribs are connected by means of a clear interstitial membrane, which in the distal portion is not interrupted by cross-pieces or other visible structure. The extreme tips of the ribs are free. The disc is clear, usually triangular and apparently bilobed.

It is not easy to bring the structure of these remarkable bodies into relation with that of the usual type of plume-scale. It may however be plausibly conjectured that the chitinous ribs, though comparatively few in number, and somewhat irregular in disposition, are homologous with the similar structures to be observed more or less distinctly in the scent-scales of many other genera. The distal portions of the ribs, or their free extremities, may conceivably correspond more or less exactly with the fimbriae of the ordinary plume-scale, which in many cases appear to be simple prolongations of the intra-laminar ribs. It is worthy of note that among the ordinary scales of most, perhaps all, of the species of African *Mylothris*, some occur of a peculiar shape; being nearly rectangular and provided with sharp, proximal spines. These peculiar scales often exhibit a row of distal projections, caused by protrusion of the ribs beyond the general border of the scale. So far as my observations extend, these scales are confined to the male sex. They certainly suggest comparison with the curiously specialised scent-scales of the genus.

With regard to specific differences within the limits of the genus, there is not much to be said. The median constriction of the lamina is very slight in *M. jacksoni*, less slight in *M. bernice* and *M. rubricosta*, moderate in *M. chloris* and *M. rüppellii*, and strongly marked in *M. agathina*, *M. phileris* and *M. poppea*. The base in all the forms is angular rather than rounded; in those species where the constriction is best marked, the proximal portion of the lamina is broadened at the base. *M. poppea* may have indications of basal cornua. The ribs in some species are beaded; this is very

evidently the case in *M. jacksoni*, and may also be seen in *M. rüppellii* and *M. agathina*. The lateral connections between the ribs in the proximal part of the scale are especially prominent in *M. jacksoni*. In *M. rubricosta* the ribs of the distal part, after their original divergence, appear to converge and then again to separate slightly; the interstitial membrane ceasing at the point of nearest approach. The disc, which preserves the same bilobed character throughout the genus, is large in *M. chloris* and *M. agathina*, moderate in *M. rüppellii* and *M. phileris*, small in *M. bernice*, *M. rubricosta*, *M. poppea* and *M. jacksoni*. The scent-scales from one of the transitional forms between *M. chloris* and *M. agathina* bear a closer resemblance to the latter than to the former. Two specimens of "*M. poppea*" show differences in the form of the lamina, one having definite cornua and a less strongly-marked median constriction. Both are from Lower Nigeria. A feature especially well seen in *Mylothris* is the convergence of the ribs of the scent-scales proximally towards the footstalk, presumably to take up the odoriferous substance conveyed by the latter. In scales of the ordinary type, the ribs take throughout a nearly parallel course, with little or no reference to the footstalk. This applies to all genera.

In the genus *Elodina* I have so far failed to find scent-scales. In the species of *Nychitona* from Africa I have been equally unsuccessful, though I have examined many specimens of the different forms to be found in that continent. After this experience, I scarcely expected the Asiatic *Nychitona* to yield any positive result; however, on examining a preparation taken from a specimen of *Nychitona xiphia* captured at Singapore, I was agreeably surprised to find numerous plume-scales of a form different from any that I had previously met with. The lamina of these structures is shaped like the blade of a mason's or bricklayer's trowel; the apex is sharp and the base rounded. The fimbriae are rather long and distinct, the footstalk straight, the disc cylindrical with a proximal orifice.

The Hope Collection possesses a co-type of the large *Nychitona* captured by Wallace in Celebes, and described by him as *Pontia dione*. Scent-scales from this specimen are of the same general character as those of *N. xiphia*, but the

lamina is much broader. The fimbriae are rather long and distinct ; the footstalk is straight, terminating in a cylindrical disc with a minute proximal orifice. The base of the lamina is rounded ; almost semicircular. The scent-scales in this specimen are not numerous.

We now come to the large group of Pierines in which the anal valves of the male are furnished with a conspicuous tuft of hairs. This peculiarity was first brought into notice by Mr. A. R. Wallace, who founded upon it his genus *Tachyris*. At the present time it has been found convenient to subdivide Wallace's genus ; and the generic or subgeneric names *Glutophrissa*, *Phrissura*, *Appias*, *Saletara*, *Hypocritia*, and *Catophaga*, in addition to *Tachyris*, are all in use. It may be doubted whether each of these sections, though the arrangement is serviceable in practice, forms a perfectly natural group ; I much question, for example, whether there is any good distinction between *Glutophrissa* and many species of *Phrissura* ; while two or three forms of the latter genus appear to stand apart from the rest. *Tachyris* again, even as at present restricted, is not homogeneous ; the *celestina* group being somewhat sharply marked off from that assemblage of species that centres round *Tachyris hippo*.

The genus or subgenus *Glutophrissa* is common to Africa and South America with the West Indies ; *Phrissura* is African and Oriental ; the remaining genera are Oriental and Australian. *Glutophrissa* in America consists of several subspecies or local races which may all be ranked under the general head of *G. drusilla*. Similarly, the African species, *Glutophrissa saba*, occurs under somewhat different forms in different parts of the Ethiopian province, including Madagascar.

In *Glutophrissa drusilla* from Guatemala the scent-scales are numerous. The sides of the lamina are parallel ; the apex moderately sharp ; the base rounded at the corners. The fimbriae are distinct ; the footstalk often bent ; the disc somewhat elongated and furnished with an orifice. In a specimen from Brazil, the lamina is generally a little longer in proportion to its breadth than in the individual just described from Central America.

In *Glutophrissa saba* the scent-scales are much like those

of the American species. The lamina, however, is broader in proportion and the apex somewhat blunter. The base is less rounded, and has a well-marked clear area. The fimbriae, somewhat shorter than in *G. drusilla*, are distinct; the disc moderate in size and cylindrical.

The plumules of *Phrissura lasti*, which are numerous, are much like those of *Glutophrissa*. The lamina is longer in proportion than in *G. saba*, bearing in this respect a greater resemblance to the American species. The disc, as in the forms above described, is moderate in size and cylindrical.

Phrissura sylvia has fairly numerous scent-scales. They are not unlike those of *P. lasti*, but broader in proportion. The fimbriae show a lyriform arrangement at the apex of the lamina; this is also visible in *P. lasti*, to some extent in *G. saba*, and occasionally in *G. drusilla*.

The scent-scales in *Phrissura phaola* and *P. nagare* are of a somewhat different character from those in the rest of the genus. In *P. phaola* they vary a little in breadth, but are always slightly goblet-shaped; with the base rounded, the sides diverging slightly towards the distal aspect, and a well-defined clear area at the base. The fimbriae are very short; the footstalk is usually bent; the disc is large and oval, showing often a distinct proximal aperture.

Phrissura nagare has plumules like the last, but generally broader. The base of the lamina is less rounded and somewhat tapering; the basal clear area is less well-defined. The sides, as before, diverge distally; the fimbriae are not quite so short. The disc is large, and may be oval or spheroidal.

Phrissura aegis from the Philippines presents us with a scent-scale having a long, narrow lamina, with slight lateral compression and rounded base. There is a well-defined clear basal area; the fimbriae are long, the disc small and oval. The scale is not much like that of an African *Phrissura*, but rather recalls that of a *Tachyris* of the *hippo* group.

In *Appias libythea* the sides of the lamina are nearly parallel; the base almost squared, or with a slight indication of cornua. The disc is oval, moderately large, and generally shows a very distinct orifice, not always terminal. The lamina in *Appias zelmira* is a little shorter and broader than in its congener.

The sides are slightly convex, usually converging towards the apex, which is sharp. The fimbriae are rather short; the base has its angles slightly rounded off. The disc is spheroidal or chestnut-shaped.

In both species of *Saletara* the scent-scales are numerous. They are small; in *S. panda* markedly smaller than the ordinary scales. The laminae in *S. liberia* are somewhat variable in length and breadth; they are usually constricted in the middle, and are occasionally goblet-shaped. The fimbriae are distinct; the base well rounded; the disc small, narrowly conical, and proximally truncated. *S. panda* has plumules similarly variable in shape; like the last they show a median constriction and a well-rounded base. The disc again is small, almost linear, and presents a similar proximal truncation.

We now come to a group of these brush-tailed Pierines, the members of which possess certain obvious characters in common. This is the group to which Mr. Wallace's original generic name of *Tachyris* is still applied. It appears to fall into two sections, the first of which consists of *Tachyris celestina*, *clementina*, *placidia*, *zarinda* and *nero*. The mutual affinity of these forms is borne out on an examination of their scent-scales, as regards both their structure and their distribution. The most noticeable characteristic of the assemblage from this point of view is the large size and usually pyriform outline of the disc. Another remarkable feature is the difference in the shape and size of the scale, and in the relative proportion of its several parts, according to the region of the wing from which it comes.

Thus, on the forewing of *Tachyris celestina* ♂, the plume-scales, which are not numerous, somewhat resemble those of *Appias libythea*, having the sides parallel or with a very slight distal convergence; the fimbriae straight and rather short; the base squared, with a bare indication of cornua. The disc is moderate in size and pear-shaped. But if the hindwing be carefully examined, a patch will be observed about half-way along the inner margin, which is distinguished by its paler colour from the general blue tint of the upper surface. This patch is practically a "sex-brand." It contains

in great abundance plume-scales of a very different character from those sparsely distributed over the forewing. These "brand-scales," as they may be called, have a lamina which is sagittate or hastate, the sides converging regularly from base to apex. The laminae vary somewhat in length and breadth, but the apex is always sharp and the basal cornua distinct. The fimbriae are rather short, generally straight, but with a sharp curve near the distal termination. These laminae are considerably larger than those of the forewing, but the most remarkable thing about the brand-scales is the enormous size, both relative and absolute, of the accessory disc. This is sometimes quite half the size of the lamina itself; it is pear-shaped, occasionally with a distinct narrow proximal prolongation. There is an evident proximal aperture, and the internal chitinous tubing is distinct. The footstalk is straight and rather wide. A feature to be found, as above noted, in very many species, is here well-marked; viz. that the ordinary scales from the forewing tend to be dentated distally, whereas in those from the hindwing the distal margin is usually smooth.

In *Tachyris clementina* there is less difference than in the preceding species between the scales of the sex-brand and those of the general surface. The latter on the forewing are scanty; larger than the corresponding scales in *T. celestina*; the lamina is cordate, with sides curving convexly from base to apex; the apex is sharp; the base has no distinct cornua; the moderately large disc is provided with a proximal aperture. *T. clementina* possesses a sex-brand on the hindwing like that of *T. celestina*. The plumules in this situation are abundant, the laminae are cordate, with the apex prolonged and very sharp. The basal cornua are strongly developed; the disc is large, pyriform, with proximal aperture. Under a low power and by transmitted light the disc looks dark in comparison with the lamina; this is probably due to its well-marked internal system of chitinous tubing.

The forewing of *Tachyris placidia* contains numerous scent-scales; these are large, subcordate and broad. The cornua are remarkable, being very long and tapering; they are often waved, and are turned inwards so as almost or quite to meet

each other, and frequently to obscure the disc. This is large and chestnut-shaped. A similar brand to that seen in *T. celestina* and *T. clementina* exists in *Tachyris placidia*, but in this case it is dark instead of pale. The plume-scales here are again numerous, and not unlike those of *T. celestina* from the corresponding situation. They are sagittate, tapering from base to apex; the cornua are here far less marked than in the scales from the forewing—a quite exceptional arrangement. The disc is very large, with an evident internal chitinous tubing; it is pyriform or flask-shaped with proximal aperture. The fimbriation is sometimes unsymmetrical, being continued further down from the apex on one side than on the other.

Tachyris zarinda possesses on its forewing an array of scent-scales somewhat resembling those of *T. celestina*; and, like them, not very numerous. The laminae are somewhat broader than in that species; the sides show a very slight distal convergence; the base is nearly square, and the disc is moderate in size, oval or triangular. There is no very evident scent-patch on the hindwings; but scales from the position occupied by the patch in other species of *Tachyris* have laminae that are cordate with a sharp apex, like those of *T. celestina* and other forms just described. They are, however, generally broader and show less indication of cornua. The disc is large, though not so large as in the preceding species; it is chestnut-shaped, has a slight proximal projection, and usually a very distinct proximal orifice.

In *Tachyris nero* there is less difference between the scent-scales of fore- and hindwing than we find in the allied forms above mentioned. The scales from the forewing are like those of *T. zarinda*, but their laminae have parallel sides and rounded bases. The apex is less sharp than in *T. zarinda*, and the disc is smaller. Scent-scales in the situation of the brand are not numerous; the laminae are broader than in those from the fore-wing, and there is a slight indication of cornua. The apex is sharper, though again less sharp than in *T. zarinda* and other allied forms, and the sides are nearly parallel until the fimbriae begin. The disc is pyriform and only moderately large.

The scent-scales in *Tachyris domitia*, the form representing *T. nero* in the Philippines, are not unlike those of *T. nero*, but show in some respects a transition from that species towards *T. zarinda*. Thus, in scales from both fore- and hindwing the base of the lamina exhibits indications of cornua; in scales from the latter region the apex is prolonged, and the sides of the lamina appear to converge slightly towards the distal margin. The disc, which is elongated and pyriform, approaches *T. nero* rather than *T. zarinda*. In the hindwing the elongation of the disc is often extreme.

With *Tachyris hippo* we enter upon a new section, characterised by scent-scales with long, narrow laminae and minute accessory discs. There is no definite sex-brand like those in *T. celestina* and its immediate allies, but there are usually slight differences to be observed between the scales from the fore- and hindwing respectively.

In *T. hippo* itself, the scales from the forewing have the lamina elongated, with sides tapering very slightly towards the apex. The base shows a tendency to cornuation; the fimbriae are long and wavy; the disc elongated and very small. The scent-scales from the hindwing are somewhat larger; moreover the sides of the lamina do not converge, but show a slight median compression. In other respects they resemble those from the forewing.

In *Tachyris adu* I have not found scent-scales. In *T. nephele* they occur, but not abundantly. They are of quite the same character as in *T. hippo*; the laminae in those from the hindwing are rather longer and narrower than in the rest, and their sides are perhaps more nearly parallel.

The plume-scales in *T. hombronii* clearly belong to the *hippo* group. As in those of the preceding species, the lamina is long, rectangular, with sides very nearly parallel; the base slightly cornuated, and the disc very small, almost linear. The scales from the hindwing vary somewhat in breadth, but are generally broader than those from the forewing.

The scent-scales of the *hippo* group recall those of "*Phrisura*" *aegis*, except for the rounded base of the latter. They may also be looked upon as an enlarged and elongated version of the scales in *Saletara liberia* and *S. panda*.

In *Hyposcritia lalage* the laminae are rather short, broad, and laterally compressed. The base is rounded; the disc small, oval or circular, and rather thickly loaded with chitinous tubing. On the hindwing the laminae are somewhat shorter, the sides more nearly parallel, and the base more rounded.

Certain specimens from Manipur, which I have been accustomed to consider as a dry-season form of *H. lalage*, show such differences in respect of their scent-scales as to suggest that they must be specifically distinct. In *H. lalage* the scent-scales are scanty everywhere; the laminae show a tendency to hour-glass compression; the discs are elongated and translucent. In the "dry-season" form referred to the scent-scales are abundant in the forewing; the laminae are long, with parallel sides; the disc is circular and opaque.

Hyposcritia lagela has on the forewing scent-scales which vary a little in shape, but generally recall those of the genus *Saletara*. They are, however, larger than in that genus, and the disc is differently shaped and larger in proportion. Lateral compression is well-marked, the base is rounded, the disc is circular and provided with a strongly-developed chitinous internal structure. On the hindwing the scent-scales are again variable, but usually larger than on the forewing. Some resemble those of the forewing; others are cordate in outline, and but for the small size of their discs would recall those from the forewing of *T. clementina*. Perhaps on the whole they are, though considerably larger, most like the scent-scales of *Appias zelmira*. A curious plume-scale, with sides straight and slightly diverging and no disc, has been observed in a preparation made from this species.

The scales in *H. indra* are rather variable, but on the whole they closely resemble those of the forewing of *H. lagela*.

The scent-scales in *H. pandione* from Java are like those of *H. lalage*. The disc is smallish, circular, and opaque. The scent-scales in *H. leptis*, also from Java, are like those of the "dry-season" form described under *H. lalage*.

Hyposcritia plana from Borneo has scent-scales like those of *H. leptis*, but with the lamina a little shorter and broader. The sides are very nearly parallel, the base is slightly rounded. The disc is generally circular, and has the appearance, common

in *Hyposcritia*, of great brightness by reflected, combined with opacity by transmitted light. It is occasionally notched, or otherwise irregular in outline. On the hindwing the lamina is usually longer.

The scent-scales in *Catophaga* are not widely different from those in *Hyposcritia*. A specimen of *Catophaga paulina* from Ceylon has the sides of the lamina parallel, the base slightly rounded, the disc moderate in size and oval. In a specimen from Bengal the lamina is broader, the sides slightly convergent towards the apex, the disc small and elongated. *Catophaga agave* shows on the forewing a rather small plume-scale; the sides of the lamina are laterally compressed, the base rounded, the disc small and oval. On the hindwing the scent-scales are similar in shape, but longer.

In *Catophaga melania* the lateral compression is better marked, and the base shows signs of cornuation. The disc, as before, is small and rather narrowly oval.

Udaiana cynis has a scent-scale which is very much like that of a *Catophaga* or a *Hyposcritia*. The lamina shows a lateral compression, the proximal being broader than the distal dilatation. The base is rounded, the disc rather small, circular or oval.

We now come to the well-marked genus *Huphina*, Oriental and Australian in distribution, which offers in many of its members so curious a parallelism in aspect with forms of the genus *Delias*. A comparison of the scent-scales shows that the resemblances between the genera are more than superficial. The scent-scales in *Huphina* at once recall those of *Delias*, from which they can scarcely be distinguished except by the comparative smallness of their accessory discs. Their likeness also to the *phaloe* group of *Pieris* is remarkable. A characteristic feature of the special scales in *Huphina* is their great relative abundance. In this respect likewise they resemble both *Delias* and the *phaloe* section of *Pieris*.

Huphina boisduvaliana presents a scale with lamina of the elongated pear-shape so frequently met with in the two genera just mentioned. The base is rounded; the disc small, circular or triangular. On the hindwing the special scales are similar, but the lamina is broader at the base and a little

shorter. The lamina in *Huphina pitys* is elongated and cordate, the sides tapering more abruptly than in the last species. The disc is small and circular, looking dark from the enclosed chitinous tubing. On the hindwing the special scales are similar, but broader at the base. The plume-scales in *H. wallaceana* are obclavate, less broad at the base than in the two preceding species, and tapering much more gradually. *H. quadricolor* has plume-scales of much the same character, but a little smaller. In *H. agnata* we meet with a scale which may be called triangular with elongated apex. The disc, as before, is small.

The scent-scales in *Huphina nerissa* are extremely abundant, apparently outnumbering those of the ordinary form. The laminae are very long, obclavate, tapering gradually up to the distal extremity; the disc is small and circular. In *H. lea*, again, the scent-scales appear to preponderate over the others. They are slightly shorter than in *H. nerissa*, and the lamina is a little broader at the base; hence the tapering is more abrupt than in that species. The condition in *H. nadina* is much the same, the scent-scales being very numerous, with laminae shaped like an elongated racquet. They are, however, somewhat shorter than is usual in this genus.

The scent-scales in *Huphina naomi* and *H. judith* resemble those in *H. lea*; the scales from the hindwing being generally, though not invariably, a little shorter and broader than those from the forewing. In *H. olga* and *H. aspasia* they are enormously long on the forewing, tapering gradually to the apex from a rounded base; on the hindwing they tend, as before, to somewhat greater breadth and shortness. The disc in these species, though still small, is larger than in the otherwise similar forms of *Pieris*.

Huphina periclea, *H. scyllara*, *H. remba*, *H. andersonii*, *H. julia* and *H. eperia* form a group in which the scent-scales all display, in slightly varying amount, an elongated pyriform outline like that seen in *H. boisduvaliana* and *H. pitys*. The scent-scales in *H. abnormis* are exceptional in the genus, being relatively very small, with the laminae laterally compressed, and not tapering to a point. They have, however, the rounded base and small circular disc characteristic of *Huphina*.

In the Central Asian genus *Metaporia* I have so far failed to find plume-scales of any description.

In the genus *Ganoris* we have *G. rapae*, *G. napi*, and the allied forms, with scent-scales similar to one another though specifically distinct. *G. brassicae*, with its geographical races, stands somewhat apart from the rest in this as in other particulars. The lamina of *G. brassicae* is very long, cordate with distinct cornua, the sides tapering gradually towards the narrow distal extremity, which is squared, not pointed, and furnished with fimbriae which are long, filiform and irregularly disposed, forming a sort of tangle. The plumule in *G. wollastoni* is scarcely to be distinguished from the preceding, but that of *G. cheiranthi* tends to be somewhat longer, and also thicker towards the apex.

The plume-scale of *Ganoris rapae* is well known. Its lamina is strongly cordate, with the distal portion elongated. The basal cornua are strongly marked, and the apex is sharp. The chitinous sculpturing is elaborate, consisting of longitudinal bars with frequent lateral connections. The bars, which follow roughly the contour of the lamina, converge towards the apex, forming an irregularly granular area at about a third of the distance from the apex to the base. The portion distal to the granular area is almost clear, but marked with fine longitudinal and parallel lines, probably corresponding to the fimbriae. The disc is moderate in size and nearly circular. The scent-scale in *G. canidia* much resembles this, but the narrowing of the lamina towards the apex is more abrupt, the sides of the distal portion being parallel. The cornua are more pronounced than in *G. rapae*. The scent-scale of *G. napi* resembles the last, but the lamina is somewhat larger, and has the cordate form still more distinctly marked, the sides of the proximal portion showing a strong convexity. The cornua are broad, blunt and very pronounced; they are generally turned inwards towards the middle line. The axes of the distal and proximal parts of the lamina are in these three species usually inclined to one another at an angle. The scales, both ordinary and special, of *Ganoris canidia* and *G. napi* suggest those of some forms of *Pinacopteryx*. The ordinary scales of *Ganoris brassicae* are very different from any of these, being very long,

narrow and straight-sided, showing no sign of spatulation. In every species of *Ganoris* known to me, but especially in *G. brassicae*, the scent-scales are abundant.

The plumule of *Ganoris crucivora* is much like that of *G. rapae*; those of *G. oleracea*, *G. melete* and *G. ajaka* are more of the *napi* type. *G. oleracea* is remarkable in having the cornua ending in sharp spines, which give a perfectly distinctive appearance to the plumule of that species. A certain approach to this condition is seen in *G. ajaka*, where many of the plumules have a rudimentary spine on one or both cornua. Forms included under the name of *G. melete* have scent-scales showing differences which may be specific. One such form has accessory discs which are enormously large in proportion to the laminae.

With respect to their scent-scales, the members of the genus *Synchlœ* show a strong resemblance to many forms of *Euchlœ*. The laminae, for instance, in *S. chloridice* are strikingly like those of *Euchlœ creusa*, exhibiting a similar expansion towards the blunted distal margin. The discs in both genera are small, and circular or oval. *Synchlœ hellica* and *S. johnstonii* have plume-scales of the like character, while those of *S. glauconome* differ chiefly by the sharpness of their apex. The laminae in *S. daplidice* vary considerably in breadth; they bear much resemblance to those of *E. ausonia* and *E. belemia*, having like them a somewhat short apex. In both genera, *Euchlœ* and *Synchlœ*, the laminae are characterised by a well-marked longitudinal ribbing, which is in obvious relation with the fimbriae.

The genera *Baltia* and *Phulia* appear to be devoid of plume-scales. Their ordinary scales are peculiar, being unusually short and broad; in which respect they are in some degree resembled by those of the genus *Tatochila*.

The scent-scales of this latter genus are not altogether dissimilar from those of *Synchlœ*, though generally very much larger. They show interesting specific differences; the lamina, which is basally squared in *T. stigmadice* and rounded in *T. xanthodice*, being shaped like the blade of a mason's trowel in *T. theodice*, and having convex sides in *T. autodice*.

In *Pontia soracta* the plume-scales, which are very numerous,

are broadly goblet-shaped. The base is slightly rounded, the distal margin segmentally arched, not angulated. The fimbriae are short, waved and discrete. The scales vary somewhat in breadth and in other particulars. This is also the case with *P. crataegi*, where however the sides are usually parallel and the base rounded. The apex is sharp, as often in *Tatochila*, and the fimbriae resemble in character those of *P. soracta*.

The scent-scales in *Neophasia menapia* are found with difficulty, being to all appearance very scanty. They are peculiar in aspect, long and narrow, with the sides nearly parallel and the base sloping away into a footstalk which terminates in a slight expansion representing the accessory disc. In one of these scales the distal extremity is rounded, and a central tuft of very short fimbriae occupies about half of the distal margin; in another, the distal extremity has a distinct apex provided with very short fimbriae along its whole extent. The aspect recalls that of the narrower plume-scales in *Synchlœa daplidice*, where also the fimbriae may be very short.

One of the most interesting members of the Pierine subfamily is the gregarious nest-making butterfly *Eucheira socialis*. This insect disappoints expectation by providing nothing in the way of scent-scales which might help in determining its affinities. If such structures exist, I have so far been unable to find them.

With *Eucheira* we may end our present survey of the Pierine subfamily. It now remains to notice some of the general results that the consideration of the Pierine plume-scales enables us to reach.

In the first place, it is obvious that inasmuch as the occurrence of these structures within the subfamily is not universal, we may make a rough division of the Pierines into those that possess them and those that do not. Such a division, however, though good in logic, would not by itself form an accurate basis for zoological classification. It would, for example, not only separate the *Idmais* group of *Teracolus* from the bulk of that genus, for which doubtless there is something to be said, but it would throw the African species of *Nychitona* into one section and the Asiatic species into the other; besides intro-

ducing a similar division into such genera as *Tachyris*, *Euchloe*, *Synchlœ*, and *Teracolus* proper itself. Facts such as these prove that too much dependence must not be placed on the presence or absence of the plume-scales as evidence of affinity. Nevertheless, it is quite certain that, if conducted with due discrimination, the examination of the occurrence, and still more the character, of these organs is capable of giving valuable assistance in the way of confirming or correcting the conclusions arrived at from other sources.

Thus, we have seen that the genus *Daptonura* is shown by the unique character of its plume-scales to be really a natural group; and on the same evidence we must pause before we consider it to be so nearly allied to *Belenois* as on the strength of other characters we might be tempted to suppose. Again, no assemblage could be more clearly marked out as closely related among its own members, and isolated from all other forms, than is the African section of *Mylothris* by its very peculiar scent-scales. On the like evidence we perceive that the resemblance borne to the African by the American species of that genus in the matter of neurulation is merely superficial; and that the true affinities of the so-called American *Mylothris* are with a certain section of another genus, the so-called *Pieris*, inhabiting the same zoological region with itself.

The obvious resemblance between such forms as *Euchloe cardamines* ♀ and *Synchlœ daphidice* suggests that in spite of certain differences in neurulation these two genera must be closely allied. This suggestion is quite borne out by the characters of their respective scent-scales; and a further examination of the same structures indicates that there is no very near relationship between *Synchlœ* and the groups represented by *Ganoris rapae*, *napi* and *brassicae*.

It has already been pointed out that the three recognised sections of *Eronia*, viz. *Nepheronia*, *Leuceronia*, and *Eronia* proper, are easily distinguishable by their scent-scales; a kind of bridge between the first two sections being afforded by *Nepheronia avatar* and *Leuceronia thalassina*. In this, as in many other Pierine assemblages, it is noticeable that specific distinctions between the plume-scales, though nearly always present and recognisable, are often very slight; that the

passage, in fact, from race to race and from species to species is commonly a gradual one. On the other hand, we do from time to time meet with cases that may come under the head of discontinuity; thus, while the scent-scales from the West African form of *Leuceronia argia* show very slight variation in structure from those of the Southern race or subspecies, the distribution of these scales on the surface of the wing is completely different in the two forms. On the other hand, the scent-scales in *Leuceronia buquetii* and in *Belenois gidica*, considered in relation to their congeners, may be said to be discontinuous in form though not in distribution. The sporadic cases of absence of scent-scales in the midst of genera usually possessing them, for instance *Teracolus auxo* and *T. incretus*, also apparently *Tachyris ada*, may likewise be accounted as instances of discontinuity.

In the genus *Pereute* the scent-scales constitute a fairly continuous series. But it is to be observed that if the species of *Pereute* were arranged according to the character of their scent-scales, the arrangement would not coincide with that founded upon the modifications of the colour-pattern. Thus, the plume-scale of *P. swainsonii* is very like that of *P. callinice*, but that of *P. antodyca* is quite different. *P. swainsonii* and *P. antodyca* are, however, like one another in general aspect, and unlike *P. callinice*. If we had only the scent-scales of the two former species to go upon, we should say, "here is discontinuity"; but another species, *P. callinira*, though discontinuous in aspect, supplies a link in the matter of scent-scales. Many reasons might be adduced in explanation of this phenomenon, which after all is only one instance of a principle constantly to be met with in all taxonomic investigation. One feature in the case may here be noticed: there can be little or no doubt that mimicry in one form or another has exercised a disturbing influence on the general aspect of the species of *Pereute*. From this influence the scent-scales must be free; and they are therefore, wherever this and similar factors are concerned, likely to be more trustworthy guides than the general aspect to the true affinities of the species.

Pereute swainsonii and *P. antodyca*, though so near to one

another in general aspect, can be distinguished at a glance, as we have just seen, by the character of their scent-scales ; and this serves to illustrate the usefulness of these structures as aids in specific diagnosis. I have found them, for instance, of great service in distinguishing between the extreme dry-season forms of some tropical species of Pierines. These may sometimes resemble each other so closely in general aspect as to baffle even the experienced naturalist. Another interesting case is the following—A rather worn and battered Pierine was brought from Mexico, and pronounced by competent authorities to be probably a *Ganoris*. The occurrence of a member of this genus in such a locality would be, to say the least, remarkable ; and I thought it desirable to submit the specimen to a careful examination. The microscopic inspection of a few scales showed me at once that the butterfly was neither a *Ganoris* nor a *Synchloe*, but a *Leptophobia*. A similar test proves the very curious South American form *Mathania agasicles* to be practically a *Hesperocharis*.

In some instances, as in the two *Pereutes* lately mentioned, the examination of a single scent-scale from each would be sufficient to separate the species ; but this would not always be the case. Just as in the use of the ordinary methods of diagnosis one may sometimes doubt about a single specimen, but find one's difficulties removed if a series is available, so with the scent-scales. And in measuring, or otherwise estimating, the average character of the scent-scales in a given preparation, we have the advantage of knowing that they all come from a single individual ; whereas we cannot always be certain that a supposed series of a species is really homogeneous. It is of course a limitation to this method of diagnosis that the scent-scales belong only to the male sex. This is a limitation shared to a very great extent by diagnosis from the genitalia ; but it is largely counterbalanced in the case of the scent-scales by the ease with which the examination can be made, by the facts that no special mode of preparation is necessary, and that the requisite material can be obtained without in the least interfering with the natural appearance of the specimen ; also by the further fact that few specimens are so badly preserved as not to afford ample scope for this kind of investigation.

We have seen that the evidence of the scent-scales demonstrates that the assemblage known in some arrangements as *Mylothris* is heterogeneous. We have observed also that the same is true of the South American genus called by Dr. Butler *Pieris*, and perhaps more usually known as *Perrhybris*. It has further been pointed out above that examination of the scent-scales suggests modification of the existing subdivisions of the old genus *Appias* or *Tachyris*. Thus, part of *Phrissura* seems indistinguishable from *Glutophrissa*; while another part, consisting of the Eastern species, is probably more nearly allied to the *hippo* section of *Tachyris*; a third part standing at a little distance from the rest. But the use of the scent-scales in suggesting differences between the members of assemblages supposed to be homogeneous is not confined to genera or subgenera. It can be carried into the domain of reputed species, and is of avail in the discrimination of subspecies or local races. An instance of this is afforded by two forms of *Ganoris* from the Far East, which, following Mr. Leech, I have been accustomed to rank together under the head of *G. melete*. But the differences between their plume-scales are so marked that, as stated in a previous part of this address, the question must be raised whether they are not specifically distinct. It will be recalled that there appears to be an appreciable, though slight, difference in respect of the scent-scales between African and Indian specimens of *Belenois mesentina*, while in addition to a small variation in form there is a marked difference in distribution of the scent-scales between the two geographical races of *Leuceronia argia*.

The question may fairly be asked whether any light is thrown by these means on Pierine phylogeny, and whether any conclusions emerge as to the developmental history of the plume-scales themselves. To such questions only a guarded answer can be given. Plume-scales, as is well known, are not confined to the Pierines, but are found in Nymphalines and Satyrines as well. Pierines are in some respects more ancestral than either of the other groups, and it may be that the origin of the plume-scales is to be sought among the subjects now before us, rather than among the groups which have not been

dealt with on the present occasion. Certainly there exist among the Pierines, as we have seen, structures which bear the appearance of ordinary scales just beginning to take on the special features of plume-scales. Such may be seen in *Euchloe*, *Euterpe*, *Neophasia* and elsewhere. The accessory disc appears to be a form of specialisation characteristic of the Pierinae, and it is natural to conjecture that those Pierine forms in which the disc is absent or ill-developed are the earlier. But it is not always easy to determine whether apparent simplicity of structure is ancestral or the result of degradation; and it would be hazardous in the extreme to pronounce, for instance, that the feeble development of the disc in *Leptophobia* is an indication of high antiquity in that genus. At the same time, I venture to think that in both *Euchloe* and *Neophasia* we have early Pierine genera, the ancestral condition of which is in some sort represented by their plume-scales. The apparent absence of these structures from such presumably early genera as *Eucheira* and *Metaporia* is noteworthy; embryological investigation might possibly determine whether in these genera they ever existed. The remarkable scale of the African *Mylothris*, so often mentioned, is comparatively simple; but I am inclined to consider its simplicity as due rather to specialisation than to the persistence of ancestral conditions. It is obvious that we have here touched upon a subject that calls for much fuller investigation.

I should wish, before concluding, to put in a word of caution. The nature of the facts dealt with in the present address is such that it has not been possible to avoid a certain appearance of dogmatism. No one can feel more strongly than I do that dogmatism is, as a rule, out of place in science; and I do not wish my statements to be taken as more than the nearest approach to truth that I have been able to make after a long-continued investigation. I am quite sensible that my results ought to be checked by other observers; and that some, perhaps many, of them will require subsequent modification. In several instances I have had to depend on the examination of single individuals, and it has not been possible for me to be sure that these examples were truly represent-

ative of their species. When I have spoken of the scent-scales as absent, it may simply be that I have been unable to find them ; when they have appeared to be scanty, it may be that the particular specimen examined has happened to have lost them ; and other sources of error may very easily exist. Nevertheless, I may be permitted to feel with some degree of confidence that much of what I have put before you is both new and true, and that a path of research has been opened which may be followed up with good hope of both interesting and valuable results.

EXPLANATION OF PLATE D.

PLUME-SCALES OF PIERINAE.

FIG. 1. *BELENOIS THYSA*—*f*, fimbriae; *l*, lamina; *s*, footstalk
d, disc.

2. *EUCHLOE CARDAMINES*.

3. *MYLOTHRIS AGATHINA*.

4. *GANORIS RAPAE*.

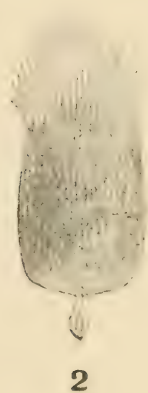
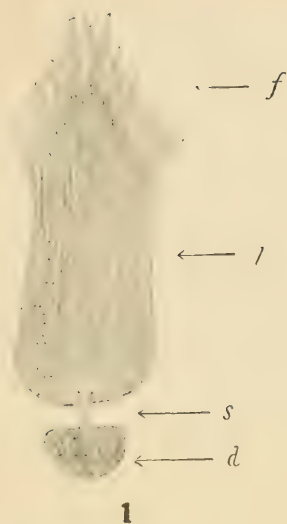
In these figures, magnified about 480 diameters, an attempt is made to represent in each case the characteristic sculpturing of the chitinous scale.

Noticeable points in *Belenois thysa* are (1) the bend in the footstalk, which as it leaves the lamina is directed first upwards and then downwards, and (2) the large comparative size and opacity of the accessory disc.

In *Euchloe cardamines* may be observed (1) the comparative bluntness of the apex, (2) the longitudinal ribbing of the lamina in relation with the fimbriae, and (3) the small size of the accessory disc.

The figure of the scale of *Mylothris agathina* shows the chitinous network of the lamina, and other remarkable features characteristic of the African *Mylothris*.

In *Ganoris rapae* should be noted the elegant contour of the scale, its elaborate and regular sculpturing, and the opacity arising from the accumulation of small granules near the apex.



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PLUME-SCALES OF PIERINAE.

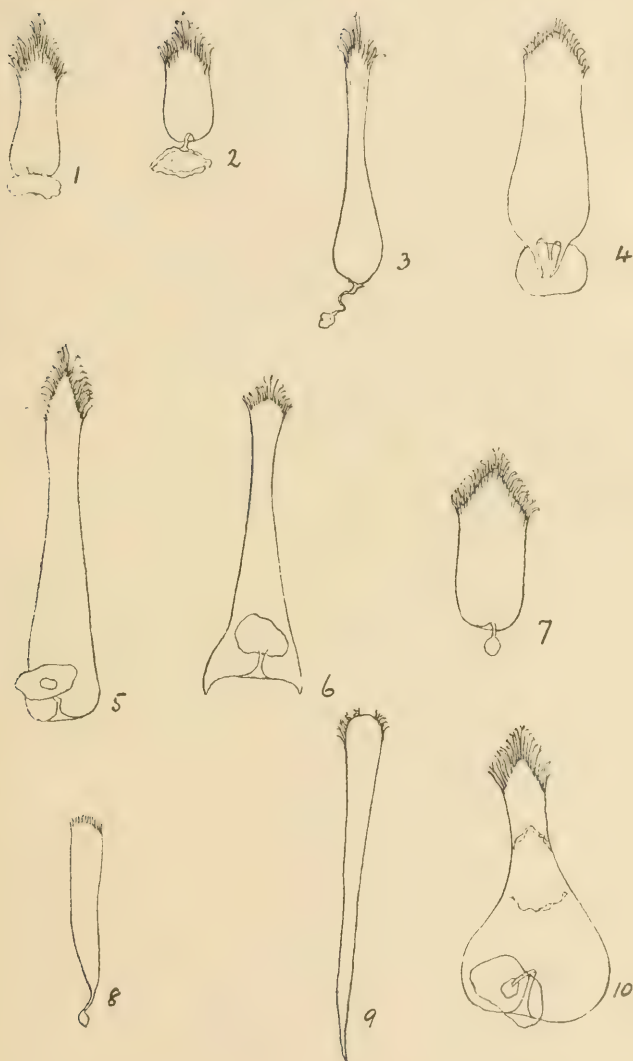
EXPLANATION OF PLATE E.

PLUME-SCALES OF PIERINAE.

- | | |
|-----------------------------------|----------------------------|
| FIG. 1. TERACOLUS PHLEGYAS. | FIG. 6. LEUCERONIA PHARIS. |
| 2. " CHRYSONOME. | 7. ERONIA CLEODORA. |
| 3. " ERIS. | 8. EUCHLOE EUPHENO. |
| 4. PTYCHOPTERYX (<i>Eronia</i>) | 9. DAPTONURA LYCIMNIA. |
| LUCASII. | 10. PINACOPTERYX LILIANA. |
| 5. NEPHERONIA PHOCAEA. | |

The scales represented in this plate are drawn only in outline, and are magnified about 260 diameters.

The figures show the large size of the disc in the purple-tipped and *protomedia* groups of *Teracolus*; the curiously attenuated scent-scale of *T. eris*; the differences characterising the three kinds of "*Eronia*"; the remarkable and unique scale of "*Ptychopteryx*" (or "*Eronia*") *lucasii*; the peculiar hair-like plumule of *Euchloe eupheno*; the still more hair-like scent-scales of *Daptonura*; and the flask-shaped lamina with large oval or figure-of-eight-shaped disc found in *Pinacopteryx liliana*.



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PLUME-SCALES OF PIERINAE.

EXPLANATION OF PLATE F.

PLUME-SCALES OF PIERINAE.

- | | |
|--------------------------|------------------------------------|
| FIG. 1. BELENOIS GIDICA. | FIG. 8. MYLOTHRIS LYPERA. |
| 2. PEREUTE SWAINSONII. | 9. LEPTOPHOBIA ARIPA. |
| 3. EUTERPE TEREAS. | 10. NYCHITONA DIONE. |
| 4. CATASTICTA FLISA. | 11. TACHYRIS PLACIDIA (fore-wing). |
| 5. DELIAS PANDEMIA. | 12. TACHYRIS PLACIDIA (hind-wing). |
| 6. PIERIS PHALOE. | |
| 7. „ PYLOTIS. | |

The figures in this, as in the preceding plate, are drawn only in outline, and are magnified about 260 diameters.

They illustrate the remarkable scent-scale, unique in its genus, of *Belenois gidica*; the extreme breadth in proportion to length found in the scent-scales of many species of *Catasticta*; the great difference in respect of these structures between the genera *Pereute* and *Euterpe*; the resemblance in lamina and difference in disc between *Delias* and a section of "*Pieris*" or *Perryhybris*; the likeness between another section of "*Pieris*" and the so-called American *Mylothris*; the wide difference between the latter and the African species related to *M. agathina* and *M. chloris* (compare Plate D, fig. 3). Other points to be noted are the minute disc of *Leptophobia*; the trowel-like outline of *Nychitona*; the relatively enormous accessory disc characteristic of the scales from the hindwing in species of the *celestina* group of *Tachyris*, and the other remarkable differences between scales from fore- and hind-wing respectively in *T. placidia*.



F. A. Dixey del.

PLUME-SCALES OF PIERINAE.

- XX. *Heredity in six families of Papilio dardanus*, Brown, *Subspecies cenea*, Stoll., bred at Durban, by Mr. G. F. LEIGH, F.E.S. By EDWARD B. POULTON, D.Sc., M.A., LL.D. (Princeton), F.R.S., etc., Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford.

PLATES XXIII AND XXIV.

[Read June 3rd, 1908.]

BETWEEN September 1902 and March 1905 Mr. G. F. Leigh has bred families twice from each of the three mimetic female forms of the south-eastern subspecies of *Papilio dardanus*, Brown. The whole of the resulting material, with the exception of a portion of the first family, exists in the Hope Department, and it is of sufficient magnitude to justify a general account and to support certain important conclusions.

The first section of this paper will deal with the hereditary relationship of the several female forms. Evidence will be produced in favour of the conclusion that their proportion, at any rate in certain localities, is due in part to the proportion and in part to the relative conspicuousness of the Danaine models.

The second section will deal with the hereditary relationship in certain elements of the mimetic pattern. The attempt will be made to show the manner in which the details of the mimetic forms have been brought to resemble those of their models.

The unfortunate clerical errors in Professor Weismann's recent use of this species as an example of mimicry ("The Evolution Theory," English transl., Lond., 1904, vol. i, Pl. I) render it very desirable that the female forms should be again represented in coloured figures, together with their models. A full correction of the mistakes here referred to will be found in the writer's "Essays on Evolution," Oxford, 1908, pp. 375, 376, from which the following passage is quoted:—"Professor Weismann's prolific labours and great discoveries give an authority and influence to these unlucky copyist's errors, and therefore it is of the utmost importance to set them right in detail" (p. 375).

TRANS. ENT. SOC. LOND. 1908.—PART III. (DEC.)

Very beautiful drawings of both surfaces of the *hippocoon*, F., parent of Family 4 and of an example of each mimetic form among its female offspring, as well as of their Danaine models, have been made by my friend Mrs. P. P. Whelpley. I desire to express my warm thanks to her for this beautiful work and the great care and skill required for its production. Mr. Abbott H. Thayer, who saw the painting, assured me that the colouring was as perfect as it could be made. Messrs. André & Sleigh have devoted great pains to Plate XXIII, containing a reproduction of the painting on the reduced scale which was unfortunately necessary. The Danaine models were all captured by my kind friend Mr. G. A. K. Marshall within a few miles of the localities where Mr. Leigh took the parents of these families.

Hereditary influence upon the details of pattern is especially well studied in Family 5, of which all the significant members are reproduced in half tone on Plate XXIV, prepared by Messrs. Witherby from a beautiful photograph by Mr. Alfred Robinson of the Oxford University Museum.

SECTION I

HEREDITARY RELATIONSHIP OF THE FEMALE FORMS OF *P. DARDANUS*, SUBSP. *CENEA*, AT DURBAN.

The one striking result which is evident on a glance at the table on p. 429, is the predominance of the *cenea* female form in the offspring of each of these families. Whether the parent be *cenea* itself or the very different *hippocoon* or *trophonius*, *cenea* is invariably most numerous represented in the offspring. In two cases no other form appeared, and in two more only a single example of another form.

The results obtained by breeding from *cenea* are very concordant—in both cases a vast preponderance of *cenea*, and in one case 1, in another 3 examples of *hippocoon*. When *trophonius* was the parent only very small numbers of offspring were reared, but the results are concordant:—only *cenea* when the numbers are very small; *cenea* with a single *trophonius* when they are larger. The results yielded by *hippocoon* were, on the other hand, astonishingly different:—in one case only *cenea*, in the other the highly remarkable Family 4 with a larger pro-

The results obtained * are set forth in the following table, in which the *cenea* female forms are considered as one, and not divided according to the white or ochreous tint of the spots in the fore-wing.

♀ PARENTS.		OFFSPRING.				COMPARATIVE DEVELOPMENT OF THE BLACK H.W. BAND OF ♂.
MIMETIC FORM OF FEMALE PARENT.	DATE OF CAPTURE.	MALES.	FEMALE FORMS.			
			<i>Cenea</i> .	<i>Hippocoon</i> .	<i>Trophonius</i> .	
1. <i>Cenea</i> , Stoll.	Sept. 18, 1902.	18	24	3	—	C
2. <i>Trophonius</i> , Westw. . . .	Sept. 18, 1903.	3	2	—	—	C
3. <i>Trophonius</i>	May 4, 1904.	6	6	—	1	A
4. <i>Hippocoon</i> , F.	Aug. 3, 1906.	14	8	3	3	C
5. <i>Cenea</i>	Jan. 14, 1907.	15	16	1	—	D
6. <i>Hippocoon</i>	March 26, 1907.	17	13	—	—	B
Totals. . . . .	. . . . .	73	69	7	4	

* An account of the first and second families was published by Mr. G. F. Leigh in Trans. Ent. Soc. Lond., 1904, p. 677, Plate XXXI; the third was described by the present writer in Trans. Ent. Soc. Lond., 1906, p. 281, Plate XVII; the fourth is briefly referred to in "Essays on Evolution," 1908, p. 72, n. 1; the fifth and sixth families are now recorded for the first time.

† The letter A represents the lightest development of the band, D the heaviest. See Plate XXIV, figs. 2-6, for a transitional series from lightest to heaviest as regards this character in five males of Family 5.

Of Family 1 the male and female parents, 6 males, 5 *cenea*, and 2 *hippocoon* are in the Hope Department. Of all the other families the female parent and the whole of the tabulated offspring except one male of Family 6, which escaped, are in the Department.

portion of both *hippocoon* and *trophonius* than any other. Looking at the six families as a whole, five yield concordant results in the vast predominance of *cenea*, while Family 4 stands apart. And even in this latter *cenea* is nearly three times as numerous as either of the other forms.

The immense preponderance of *cenea* over the other female forms in Natal has been observed in the field (Trans. Ent. Soc. Lond., 1904, pp. 687, 688). It follows from this predominance that for every male which meets and pairs with *hippocoon* or *trophonius* in Natal, several will meet and pair with *cenea*. *Cenea* ancestry will quickly predominate over that of the other forms in the males, and will also predominate in the other female forms themselves, while these latter will exert but little influence in the ancestry of *cenea*.

The two models of the *cenea* female form—*Amauris albimaculata* and *A. echeria*—are immensely predominant over any other Danaine butterfly in Natal, and especially over *Amauris niavius*, L., subsp. *dominicanus*, Trim., the model of the *hippocoon* form. The comparative rarity of the *trophonius* form in all parts of Africa, in spite of the widespread abundance of *Danaida* (*Limnas*) *chrysippus*, L., has already been alluded to by Mr. Roland Trimen, F.R.S., as a difficult problem which awaits solution (Trans. Ent. Soc. Lond., 1904, p. 688: see also p. 432 of the present memoir where the solution is attempted). In marked contrast with *trophonius*, the relative proportion of *cenea* in Natal certainly follows that of the two Danaines whose pattern it reproduces.

The interpretation offered above of the state of things proved to exist in Natal derives strong support from an investigation of these proportions in and around Chirinda Forest, Gazaland, in South-Eastern Rhodesia. A very large collection made, almost entirely in 1907, by Mr. C. F. M. Swynnerton, in this locality, has been recently examined in the Hope Department, and the numbers are sufficient to admit of fairly safe conclusions. The investigation and tabulation of the collection is still incomplete, and the figures given below will probably be slightly increased, but not to an extent which will affect the conclusions here drawn. The collection was made nearly indiscriminately, and allowing for the considerations mentioned on pp. 431, 432, the proportions of the larger species, here alone

taken into account, may be accepted as approximately correct. The numbers of *Papilio dardanus* (of which nearly all the Chirinda males possess the heavy black hind-wing band of the E. subspecies, *tibullus*, Kirby, are as follows:—

MALES	.	.	.	.	.	.	.	24
FEMALES								
	<i>Hippocoon</i> , f.	.	.	.	.	.	.	22
	<i>Cenea</i> , f.	.	.	.	.	.	.	1
	<i>Trophonius</i> , f.	.	.	.	.	.	.	1

Trophonius, mimicking *D. chrysippus*, is thus rare, as it is in Natal; but, as regards the other two female forms, the proportions are reversed, *hippocoon* being predominant and *cenea* rare. It will be of the highest interest to breed from these female forms at Chirinda. There can be little doubt that it would be found that *hippocoon* here predominates among the female offspring of a female parent of any form, just as *cenea* predominates in Natal.

When we investigate the proportions of the Danaine models at Chirinda we do not find that predominance of the black and white species of *Amauris* which is suggested by the numbers of the *hippocoon* mimetic form. The following results have been so far obtained, but a small part of the collection still remains unexamined:—

The model of <i>hippocoon</i> — <i>Amauris niavius</i> , L., subsp.	
<i>dominicanus</i> , Trim.	66
The models of <i>cenea</i> { <i>Amauris lobengula</i> , E. M. Sharpe	198
„ <i>albimaculata</i> , Butler	152
The model of <i>trophonius</i> — <i>Danaïda chrysippus</i> , L.	109

Amauris lobengula represents, and is probably a local form of, *A. echeria*, Boisd., which is still unknown at Chirinda. It is equally serviceable as a model for *cenea*. In addition to *dominicanus*, 22 specimens of the smaller black and white *Amauris ochlea*, Boisd., were counted; but the difference in the pattern is so great that it is unlikely that the influence upon *hippocoon* is greatly affected. Neglecting *ochlea*, the numbers of the Danaine model of *hippocoon* are less than one-fifth of those of the two models of *cenea*. Yet this small proportion is accompanied by the immense preponderance of *hippocoon* revealed in the figures quoted above. As bearing upon these interesting and, in view of the effect produced, remarkable proportions, Mr. Swynnerton tells me that *lobengula*

and *albimaculata* are so excessively abundant that his native boy would get tired of catching them, whereas he would secure every specimen of *dominicanus* that came in his way. But on the other hand, as Mr. G. A. K. Marshall and Mr. Swynnerton have both pointed out to me, the females of *dardanus* probably spend a great deal of their time actually in the forest, and within that particular environment there would be far less discrepancy between the numbers of *dominicanus* and the two other species of *Amauris*, than would appear from the above tabular statement. Nevertheless, it has been already shown that *echeria* and *albimaculata* are exceedingly effective models for *dardanus* in Natal, and the same is true of the south coast of Cape Colony. Making every allowance therefore for the above considerations, I am driven to conclude that *dominicanus* possesses some special advantages as a model over the other two species, which may compensate for a numerical inferiority. These advantages may be conferred by the far greater conspicuousness which renders it visible at a much greater distance than either *lobengula* or *albimaculata*.* It must be remembered furthermore that, although so much less numerous than the other two, *dominicanus* is quite a common butterfly at Chirinda, whereas in Natal it is generally rare, and often altogether unseen for long periods in many localities where *Papilio dardanus* is found.

It is interesting to compare *Papilio echerioides*, Trim., with *P. dardanus*. The former is also common at Chirinda, 39 males and 17 females having been so far counted. The females, as is well known, are beautiful mimics on the upper surface of *Amauris echeria* (or *lobengula*) and *albimaculata*. For this *Papilio* the latter are evidently very effective models, but for *dardanus*, with another form, mimicking the black and white Danaines, their influence in spite of preponderant numbers is entirely subordinate.

The relative rarity of the *trophonius* form in the west and east, as well as the south of Africa, in spite of the general abundance and wide range of its model, has often been remarked upon (see p. 430; also Trans. Ent. Soc. Lond., 1904, p. 688). In this case the facts are probably to be explained by difference of habitat, *chrysippus* being an open

* It would also be very interesting to investigate the relative efficiency of the special means of protection possessed by these three *Danainæ*.

country and woodland species, while *dardanus* is a forest insect. Model and mimic would ordinarily only meet at the lines of contact between their respective types of country. Both Mr. Marshall and Mr. Swynnerton to whom I have mentioned this hypothesis agree that it probably accounts for the fact.

SECTION II

DESCRIPTION OF FAMILIES 4, 5 AND 6: HEREDITARY TENDENCIES IN THE DETAILS OF THE MIMETIC PATTERNS.

The fore-wing spots of the cenca form.

Before describing the details of these three families now recorded for the first time, it will be convenient to enumerate the spots of the fore-wing of the *cenca* form, of which the five largest were described in 1904 (Trans. Ent. Soc. Lond., 1904, pp. 680, 681). The terminology then suggested will now be extended to include all the spots of the fore-wing:—

- A. Spots arranged in a curve in part below and in part round the distal end of the cell.
 - (1) The principal spot (oval): between veins 2 and 3.
 - (2) An elongated spot: between veins 4 and 5.
 - (2a) Rarely present (e. g. in Plate XXIV, figs. 20, 21): between veins 5 and 6.
 - (3) Oval, but broader than (2): between veins 6 and 7.
 - (4) The blunt distal end is commonly emarginate: between veins 8 and 9.
 - (4a) Occasionally present (e. g. in Plate XXIV, figs. 14–19): between veins 9 and 10.
- B. The spot within the cell.
 - (5) An irregular spot, with the inner extremity often cut off as a separate minute spot (e. g. in Plate XXIV, figs. 1, 12, 13, 16, 17, &c.).
- C. The submarginal spots, of which four are usually present.
 - (a) At the anal angle; generally minute: between veins 1 and 2.
 - (β) Generally larger: between veins 2 and 3.
 - (γ) Generally larger still: between veins 3 and 4.
 - (δ) At the apical angle, generally largest: between veins 7 and 8.

The fourth Family:—

4. HIPPOCOON, ♀ Parent (Plate XXIII, fig. 1).

Captured August 3, 1906. Laid 32 eggs, August 4-6.

Hatched August 10-12.

OFFSPRING.			
	DATE OF PUPATION.	DATE OF EMERGENCE.	SEX AND ♀ FORM.
	1906	1906	
1.	September 8	September 19	♂
2.	No date.	September 21	♀
3.	No date.	September 22	+ ♀ <i>cenea</i> (chief spot in fore-wing pale ochreous).
4.	No date.	September 23	♂
5.	No date.	September 23	♂
6.	September 13	September 23	♂
7.	September 13	September 24	+ ♂ <i>trophonius</i> .
8.	September 14	September 26	♂
9.	September 14	September 26	♂
10.	September 14	September 30	+ ♀ <i>cenea</i> (chief spot in fore-wing white. Plate XXIII, fig. 4A).
11.	September 16	September 30	♀ <i>cenea</i> (spot white).
12.	September 18	October 1	♂
13.	September 18	October 1	+ ♀ <i>cenea</i> (spot ochreous).
14.	September 20	October 2	♂
15.	September 21	October 6	+ ♀ <i>cenea</i> (spot white).
16.	September 21	October 7	♀ <i>trophonius</i> (Plate XXIII, fig. 3A).
17.	September 23	October 9	♀ <i>cenea</i> (spot ochreous, as also is the spot within the fore-wing cell).
18.	September 23	October 10	♀ <i>hippocoon</i> .
19.	September 24	October 13	♀ <i>trophonius</i> .
20.	September 24	October 15	+ ♀ <i>hippocoon</i> (Plate XXIII, fig. 2A).
21.	September 23	October 15	♀ <i>cenea</i> (spot ochreous).
22.	September 25	October 18	♂
23.	September 26	October 18	♂
24.	September 26	October 19	+ ♂ <i>hippocoon</i> .
25.	September 27	October 20	♂
26.	September 30	October 21	♂
27.	October 2	October 23	♂
28.	No date.	October 24	+ ♀ <i>cenea</i> (spot ochreous. Plate XXIII, fig. 5A).

These results are the most remarkable hitherto attained by Mr. G. F. Leigh, all the forms being represented in considerable proportions, and the predominance of *cenea* being far less marked than in any other family.

The hippocoön parent.—A glance at fig. 1 on Plate XXIII will show that the parent is a normal *hippocoön* form with spot (5) undivided.

The fourteen male offspring.—The heaviness of the hind-wing band is about as in Families 1 and 2, viz. next to the darkest, Family 5, but separated from it by a considerable interval.

The three hippocoön offspring.—The individual represented in Plate XXIII, fig. 2A, is the only one with spot (5) in the cell of the fore-wing divided. In the other two the chief white marking is smaller, suggesting the appearance of forms from the West Coast (*merope*).

The three trophonius offspring.—In all three examples a pale fulvous tint spreads from the nervules crossing the subapical white bar, and in one example also overspreads the outer half of spot (5). The lens shows that this tint is due to fulvous scales scattered over the white areas, and thickly crowded along the nervules.

Although the upper surface pattern of *trophonius* at first sight appears to be nothing more than *hippocoön* with the white of the chief marking replaced by fulvous—a view adopted by the present writer in Trans. Ent. Soc. Lond., 1906, p. 290—in certain special points it has diverged in the direction of its particular model, *chrysippus*. In the fore-wing the fulvous area invades or overspreads the black ground-colour towards the base of the cell. In the hind-wing the outer border of the fulvous area projects into the black margin between the nervules, forming a scalloped junction which, as in *D. chrysippus* itself, is more strongly marked in the costal half of the wings. The fulvous area is also more sharply marked off from the black margin than in the *hippocoön* form. These points of distinction are small and developed very variably. They are better seen when Fig. 3A is compared with Fig. 2A than when it is compared with Fig. 1.

Spot (5) is undivided in the three *trophonius* offspring.

The eight cenea offspring.—It has already been shown in the tabular statement that three of these individuals have the chief spot (1) of the fore-wing white (e.g. as in the individual shown on Plate XXIII, fig. 4A), while in

five it is pale ochreous (as in Fig. 5A). In that one specimen out of the five in which spot (1) is the palest, the spot within the cell (5) is of a pronounced ochreous tint. Spot (5) is divided on the left side of one out of the three individuals with the chief spot white: among the five with the chief spot pale ochreous it is divided in two, and on the left side in a third individual. Spot (4a) is shown on the upper but not on the under surface of the individual represented on Plate XXIII, fig. 5A. It can only be made out with a lens and on one side only in a single specimen out of seven remaining *cenca*. Excluding minute traces revealed by the lens, spot (2a) is wanting from the upper surface of all examples, but is present on the under surface of one specimen out of the three and with the chief spot white, and of two out of the five others. Other characteristics of these eight specimens are considered in the following sub-section:—

Probable hereditary effects of the hippocoon form upon offspring of other forms.

In all the three *cenca* offspring with the chief spot (1) in the fore-wing white, the costal third of the ochreous basal patch of the hind-wing becomes white, as is shown in Plate XXIII, fig. 4A. The ochreous tint of the remainder of the patch is also unusually pale. In the two individuals in which this change towards the costal border of the hind-wing is most marked, the chief spot of the fore-wing spreads outwards and downwards beyond the first median nervule (Fig. 4A). In all three examples there is a small ochreous linear mark towards the base of the inner margin of the fore-wing, thus very slightly extending the pattern of the hind-wing on to the fore.

In all the five *cenca* offspring with the chief spot (1) of the fore-wing pale ochreous, this linear mark is also present (Fig. 5A), but the extension of the chief spot is only found in two of them.

A whiteness towards the costal margin of the hind-wing upper surface, like that of three *cenca* females, is found in two of the males and on the left side of a third. There is also a paling of the yellow on one side in the cell of the fore-wing of a few males which has more of an abnormal appearance. The paling of the hind-wing, however, corresponds in position with that of the three *cenca*, and is probably due to the same cause.

The fifth Family:—

5. CENEA, ♀ Parent (Plate XXIV, fig. 1).

Captured January 14, 1907. Laid 42 eggs, January 15 and 16.

OFFSPRING.

	DATE OF PUPATION.	DATE OF EMERGENCE.	SEX AND ♀ FORM: INCREASING DEVELOPMENT OF HIND-WING BAND OF MALES INDICATED BY LETTERS A TO O.
	1907	1907	
1.	February 19	March 2	♂ C.
2.	February 19	March 3	♂ I.
3.	February 19	March 3	♂ (Plate XXIV, fig. 3) B.
4.	February 20	March 4	♂ L.
5.	No date.	March 4	♂ H.
6.	No date.	March 5	♂ <i>cenea</i> (Fig. 8).
7.	No date.	March 5	♂ <i>cenea</i> (Fig. 15).
8.	No date.	March 6	♂ J.
9.	No date.	March 6	♂ <i>cenea</i> (Fig. 20).
10.	No date.	March 6	♂ <i>cenea</i> (Fig. 12).
11.	No date.	March 8	♂ N.
12.	No date.	March 8	♂ <i>cenea</i> (Fig. 21).
13.	No date.	March 9	♂ (Fig. 5) G.
14.	February 24	March 10	♂ <i>cenea</i> (Fig. 11).
15.	No date.	March 11	♂ K.
16.	No date.	March 12	♂ <i>hippocoon</i> (Fig. 22).
17.	No date.	March 12	♂ <i>cenea</i> (Fig. 13).
18.	No date.	March 13	♂ <i>cenea</i> (Fig. 7).
19.	No date.	March 14	♂ M.
20.	No date.	March 14	♂ <i>cenea</i> (Fig. 10).
21.	March 2	March 15	♂ (Fig. 6) O.
22.	No date.	March 15	♂ <i>cenea</i> (Fig. 16).
23.	March 3	March 16	♂ <i>cenea</i> (Fig. 14).
24.	No date.	March 17	♂ <i>cenea</i> (Fig. 18).
25.	No date.	March 18	♂ <i>cenea</i> . Badly de- formed.
26.	March 7	March 20	♂ (Fig. 2) A.
27.	March 9	March 22	♂ <i>cenea</i> (Fig. 17).
28.	March 12	March 27	♂ F.
29.	March 12	March 28	♂ (Fig. 4) E.
30.	March 16	March 28	♂ D.
31.	March 14	March 29	♂ <i>cenea</i> (Fig. 19).
32.	March 20	March 30	♂ <i>cenea</i> (Fig. 9). Fore-wing spots far more ochreous than in any other.

The cenea parent.—The spots round the end of the cell (1)–(4) are large and well developed, but neither (2a) nor (4a) is present. The chief spot (1) is very pale ochreous, with a minute trace of a downward extension, as if slightly in the direction of the pattern of *hippocoon* and *trophonius*. The spot in the cell of the fore-wing (5) is distinctly divided into two, making a !-like marking on the upper surface: on the under this division does not occur. The submarginal spots of the fore-wing (a)–(δ) are present (although (a) is very minute) and increase in size towards the apex. The parent is represented in Plate XXIV, fig. 1.

The fifteen male offspring.—These are as a whole much darker and more closely approach the subspecies *tibullus* than the males of the other five families. The development of the submarginal black band of the hind-wing is clearly shown in Plate XXIV, figs. 2–6. The band is least developed, with a pronounced anal gap (Trans. Ent. Soc. Lond., 1904, p. 683) in No. 26, represented in Fig. 2. Next in succession follows No. 3, shown in Fig. 3. Then follow two unfigured individuals, Nos. 1 and 30, succeeded by No. 29 (Fig. 4). The next individual in the order of increasing heaviness in the black band is No. 28, unfigured, and next No. 13, represented in Fig. 5. In this specimen the costal gap in the band is indicated by a few scattered yellow scales. No. 13 is the only individual in which the gap is represented in this way, although it is more distinctly indicated by a bay, as in Figs. 3 and 4, or by an angle, as in Fig. 5 itself. The darkness of the band in this family and the gradual character of the transition are seen in the fact that no less than seven unfigured specimens intervene between the one represented in Fig. 5 and the darkest individual, No. 21, shown in Fig. 6. Arranged in the order of increasing darkness these unfigured specimens are Nos. 5, 2, 8, 15, 4, 19, and 11. The specimen represented in Fig. 6 resembles a typical male of *tibullus* from the tropical East coast, and indeed, as regards the band of the hind-wing, the whole of the nine darkest individuals of this family might have come from Mombasa or German East Africa.

The remarkable serration of the inner border of the black margin of the fore-wing—an ancestral feature common in the males of this specialised subspecies, but rarely found in far more primitive forms on the African

continent*—is well seen in Fig. 6, less characteristically in Fig. 2. Half of the unfigured specimens also exhibit the same feature, while the others resemble the condition represented in Figs. 3, 4, and 5.

The sixteen cenca offspring.—All the females of this form are shown in Plate XXIV, with the exception of No. 25 which is so deformed that the pattern cannot be made out. They are arranged in three sets according to the number of the white spots grouped round the end of the fore-wing cell on the upper surface. The seven specimens represented in Figs. 7–13 on Plate XXIV possess the four usual spots (1)–(4) seen in the parent; the six represented in Figs. 14–19 have the additional spot (4a) on the costal and inner side of (4): the two represented in Figs. 20 and 21 have the additional spot (2a) between (2) and (3). A glance at the plate will show that the extra spots (4a) and (2a) tend to occur in individuals in which spots (1)–(4) are strongly developed, the only apparent exception being offered by Fig. 14. The spots of the fore-wing are large and well developed—about equal or even superior to those of the female parent—in the *cenca* offspring represented in all the Figures except 7, 8, 11, and 14.

As regards the development of a pale ochreous tint in the spots of the fore-wing, all the *cenca* forms figured are nearly in the condition of the parent except that shown in Fig. 9. In this specimen, No. 32, spots (1) and (3) are of an ochreous tint as deep as that of the hind-wing patch, while parts of spots (2) (4) and (5) also bear yellow scales. The specimen is, in fact, in this respect a good mimic of the Cape Colony forms of *Amauris echeria*.

Of the remaining *cenca*, spot (1) is whitest in the specimens shown in Figs. 11 and 15. Spot (3) as well as (1) is very pale ochreous in Fig. 16. A slight downward and outward extension of spot (1) in the direction of the pattern of *hippocoön* is developed much as in the parent in the specimens represented in Figs. 9, 10, 11, 14, 17, 19, and 21. It is considerably more developed in Fig. 18. A small pale mark on the basal part of the fore-wing inner margin—a further advance towards *hippocoön*, etc., not found in the parent—is seen in the specimens shown in Figs. 10, 11, 14, 19, 21, and in a far more advanced state in Fig. 18.

* Trans. Ent. Soc. Lond., 1906, p. 282.

It is now necessary to describe, as briefly as possible, some of the chief features in the fore-wing pattern of each of the *cenca* forms:—

Fig. 7 (No. 18): spot (5), divided in the parent, is here undivided: a distinct trace of (4a) can be seen on the under surface. The marginal spots are much less developed than in the parent, (γ) and (δ) being minute and the others wanting: below (δ) is wanting also. Part of the pupal case is still adhering behind the head.

Fig. 8 (No. 6): (5) divided on right side, undivided below: very faint traces of (4a) and (2a) can be made out with a lens on the under surface. (a) can be made out with a lens, (β) minute, others small. All distinct below and (γ) large.

Fig. 9 (No. 32): (5) divided on upper surface only, but the outer portion is very minute especially on right side. The additional spots are unrepresented on under surface. (a)–(δ) well developed, (a) and (δ) more so than in parent.

Fig. 10 (No. 20): (5) undivided: under surface as in Fig. 9; marginal spots nearly as in Fig. 8. Below (a) minute on left side, (β) and (γ) large, (δ) absent.

Fig. 11 (No. 14): (5) undivided: a small but distinct trace of (2a) below: marginal spots absent above: below (a)–(γ) small and (β) barely visible on left side.

Fig. 12 (No. 10): (5) divided distinctly above and nearly divided below: (4a) distinct below and a trace can be identified with a lens above: (2a) wanting below: (a) absent, (δ) minute, others normal as in parent. Below (δ) absent: others normal as in parent.

Fig. 13 (No. 17): (5) as in Fig. 12 but the lower spot is minute, especially on right side: (2a) distinct below and (4a) a trace: marginal spots as in Fig. 12 except that (δ) is large.

Fig. 14 (No. 23): (5) divided on left side, fused but constricted on right, below fused on both sides: (4a) small but quite distinct, larger below: (γ) minute, all others absent, similar below except for a minute trace of (β) on left side only.

Fig. 15 (No. 7): (5) divided, but not below, though traces of division are distinct: (4a) as in Fig. 14 but rather larger: a trace of (2a) below: marginal spots much as in Fig. 13, but (β) even more minute above, and (a) absent above and below.

Fig. 16 (No. 22): deformed: yellower spots in fore-wing than any except Fig. 9: (5) divided below as well as above: (4a) as in Fig. 15: (2a) in two patches below: submarginal spots similar to parent on both surfaces, except that (a) is wanting above.

Fig. 17 (No. 27): (5) divided and the larger portion also nearly divided, so that the marking appears as three sub-equal spots: below the ordinary division holds and the other is indicated: (4a) as in Fig. 15 etc. and very distinct below: submarginal spots like parent but (a) (β) smaller and (γ) (δ) larger both above and below: (γ) below larger than (δ).

Fig. 18 (No. 24): (5) very large, undivided above and below: (4a) distinct above and below: no trace of (2a) below: marginal spots very similar to Fig. 17 only (a) absent above and minute below. The rather marked transition to *hippocoön* shown in this specimen has been already pointed out (p. 439).

Fig. 19 (No. 31): much like Fig. 18 except that a very slight trace of (2a) appears below, especially distinct on left side: (δ) absent above and below, others normal on both surfaces, (a) being minute above as usual.

Fig. 20 (No. 9): fore-wings deformed, especially on right side: (5) divided on both surfaces: (4a) distinct below, especially on right side, absent above: (2a) small on left side, large below; on right side invisible above (perhaps due to fold in wing); small below but evidently much concealed in fold: (γ) and (δ) alone present above: below on left side (right much deformed) (δ) absent but other three normally developed.

Fig. 21 (No. 12): (5) divided above but not below: no (4a) on either surface: (2a) very large both above and below: (a) and (β) can only be identified by a lens, (γ) and (δ) are well developed and sub-equal; below (δ) is minute on right side, absent on left, (a) and (β) normally developed and (γ) large.

The single hippocoön offspring.—The pattern of this specimen is well shown in Plate XXIV, fig. 22.

Fig. 22 (No. 16): (5) divided above but not below: (2a) is much the largest spot in the subapical bar of *hippocoön* on both surfaces. (4a) is absent, for a linear

white streak along the second subcostal does not appear to correspond with it: nor is this spot represented on the under surface. The submarginal spots are normal on the upper surface except for the absence of (α), on the lower except for the absence of (δ).

The sixth Family:—

6. HIPPOCOON, ♀ Parent.

Captured March 26, 1907. Laid ova March 27-8, and died on evening of March 28.

OFFSPRING.			
	DATE OF PUPATION.	DATE OF EMERGENCE.	SEX AND ♀ FORM.
	1907	1907	
1.	April 26	May 10	♂ cenea.
2.	April 27	May 10	♂ cenea.
3.	April 27	May 11	♂ cenea.
4.	April 28	May 12	♂ cenea.
5.	April 29	May 12	♂ cenea.
6.	April 30	May 15	♂ cenea.
7.	May 1	June 22	♂ cenea.
8.	May 2	June 24	♂ cenea.
9.	May 3	July 27	♂ cenea.
10.	May 2	July 28	♂ cenea.
11.	May 6	August 1	♂ cenea.
12.	May 7	August 5	♂ cenea.
13.	May 6	August 11	♂ cenea.
14.	May 7	August 11	♂ cenea.
15.	May 7	August 12	♂ cenea.
16.	May 8	August 16	♂ cenea.
17.	May 7	August 16	♂ cenea.
18.	May 8	August 19	♂ cenea.
19.	May 7	August 19	♂ cenea.
20.	May 10	August 20	♂ cenea.
21.	May 9	August 20	♂ cenea.
22.	May 10	August 25	♂ cenea.
23.	May 10	August 28	♂ cenea.
24.	May 11	August 31	♂ cenea.
25.	May 12	August 31	(escaped).
26.	May 11	August 31	♂ cenea.
27.	May 10	Sept. 1	♂ cenea.
28.	May 12	Sept. 4	♂ cenea.
29.	May 11	Sept. 6	♂ cenea.
30.	May 14	Sept. 12	♂ cenea.

It is not necessary to describe this family in any detail;

as its interest lies in the exclusive predominance of *cenea* female forms and in the astonishing contrast afforded with Family 4, also bred from a *hippocoön* parent. It is of considerable interest, as Mr. G. F. Leigh pointed out to me, that the pupal condition of the great majority of examples was prolonged through the winter months, although a certain number emerged after the usual period.

The hippocoön parent.—The specimen is a normal example of this form with spot (5) undivided.

The seventeen male offspring.—The variable black marking of the hind-wing was on the whole less heavily developed in the males than in those of any except Family 3.

The thirteen female offspring—entirely cenea forms.—All the thirteen specimens possess ochreous scales in spot (1), which however appears white to the naked eye in Nos. 23 and 26. Spot (1) is of a pronounced ochreous tint and (3) very faintly ochreous in Nos. 14, 17, 20 and 27. Spot (1) extends downwards and outwards, in the direction of the pattern of *hippocoön*, etc., in Nos. 14, 17, 19 and 20 and very slightly in No. 9. A slight ochreous linear mark near the basal end of the inner margin of the fore-wing also tending in the direction of *hippocoön*, etc., is seen in Nos. 1, 14, 17, 19, 20 and 27. Spot (5) is divided in Nos. 9, 17 and, on the right side, 23: it is nearly divided in No. 5.

Relation between the male offspring in the six Families.—The increasing heaviness of the black hind-wing band is shown by the letters A—D in the table on p. 429. It must be borne in mind that there is a considerable interval between stages C and D, but that the other intervals are small. In all six families the pronounced serration of the inner border of the fore-wing black margin is seen in a considerable proportion of the males, and quite as often in the more heavily marked as in the less heavily marked individuals. Indeed upon the whole it appeared to be slightly more characteristic of the latter.

Hereditary tendencies in the details of the mimetic pattern.—A comparison of the mimetic forms with one another in each family and with those of the other families indicates the ample nature of the variational material by which the mimetic pattern has been and could be again adjusted to the details of the patterns presented by the models. The condition of three elements in the pattern of the fore-wing upper surface of the *cenea* offspring, and of

one in the *hippocoön* and *trophonius* offspring of the six families, is shown below in a tabular form. When the character is present on right or left side only it is counted as $\frac{1}{2}$, and if on one side of two individuals as 1.

SPOT (5) IN ♀ PAREN'.	FEMALE OFFSPRING IN CONDITION FOR STUDY.	NUMBER EX- AMINED.	(5) DIVIDED IN.	(4a) PRESENT IN.	(2a) PRESENT IN.
Family 1.	<i>cenea</i>	6	1	0	0
<i>cenea</i> : divided.	<i>hippocoön</i>	2	1	—	—
Family 2.					
<i>trophonius</i> : divided.	<i>cenea</i>	2	0	1	0
Family 3.	<i>cenea</i>	4	1	0	0
<i>trophonius</i> : escaped.	<i>trophonius</i>	1	0	—	—
Family 4.	<i>cenea</i>	8	3	1 $\frac{1}{2}$	0
<i>hippocoön</i> : undivided.	<i>hippocoön</i>	3	1	—	—
	<i>trophonius</i>	3	0	—	—
Family 5.	<i>cenea</i>	14	9	5	2
<i>cenea</i> : divided.	<i>hippocoön</i>	1	1	—	—
Family 6.					
<i>hippocoön</i> : undivided.	<i>cenea</i>	13	3 $\frac{1}{2}$ *	2	1

* Including No. 5 in which the spot is nearly divided.

A comparison of Family 5 with the others at once shows that there are certainly hereditary tendencies in details of the pattern. If the pattern of the model became more nearly approached by the division of spot (5) in the mimic, or by the addition of such elements as (4a) or (2a), the above table supports the conclusion that selection would quickly confer these characters upon the *cenea* form of female. It is equally clear that these hereditary tendencies exist in the most varied combinations. Thus referring again to Plate XXIV, it is obvious that the addition of (4a) and (2a) tends to occur when the normal spots are well developed, but (4a) is present in Fig. 14,

where they are small. So also with the submarginal spots which vary with but also independently of the chief spots (1)–(5). Thus the apical spot (δ) may be absent when (1)–(5) are small, as in Fig. 14, or when they are large, as in Fig. 19. But upon the whole it tends to be well developed when (1)–(5) are also well developed, as in Figs. 15–18, etc.

This kaleidoscopic combination of the various elements in a pattern, added to the existence of undoubted hereditary tendencies in the associations as well as in the individual components, enables us to understand how the complex detail of these mimetic patterns has been attained.

This most valuable and interesting material, which we owe to the skill and energy of Mr. G. F. Leigh, F.E.S., thus throws a flood of light upon two difficult and fascinating problems—the proportions of the mimetic forms to those of their particular models in each locality, and the more fundamental problem of the adjustment of the details of the mimetic patterns to those of the models.

EXPLANATION OF PLATES XXIII, XXIV.

[See *Explanation facing the PLATES.*]

EXPLANATION OF PLATE XXIII.

Examples of the various mimetic forms of *Papilio dardanus*, subsp. *cenea*, bred by Mr. G. F. Leigh in 1906 from a *hippocoön* form of female, captured Aug. 3, 1906, near Durban, Natal. The figures represent four of the female offspring out of the family of 16 males and 16 females bred by Mr. Leigh. The female parent and the Danaine models are also represented. The specimens are in the Hope Department, Oxford University Museum.

All the figures are about $\frac{2}{3}$ of the natural size.

FIGS.

1. The female parent (*hippocoön*, ♀ f. of *P. dardanus*, subsp. *cenea*) : captured Aug. 3, 1906, and laid 32 eggs Aug. 4-6, which hatched Aug. 10-12.
- 2A. One of the three *hippocoön* offspring bred from the above. The larva pupated Sept. 24, and the imago emerged Oct. 15.
2. Danaine model of the above from the same locality, viz. *Amauris niavius*, subsp. *dominicanus*. The specimen, a female, was captured by Mr. Guy A. K. Marshall at Durban, April 4th, 1896.
- 3A. One of the three *trophonius* offspring bred from the *hippocoön* parent (Fig. 1). The larva pupated Sept. 21, and the imago emerged Oct. 7.
3. Danaine model of the above from the same locality, viz. *Danaida (Limnas) chrysippus*. The specimen, a male, was captured by Mr. Marshall at Malvern, near Durban, Aug. 15, 1896.
- 4A. One of the three *cenea* offspring with all the spots in the fore-wing white, bred from the *hippocoön* parent (Fig. 1). The larva pupated Sept. 14, and the imago emerged Sept. 30.
4. Danaine model of the above from the same locality, viz. *Amauris albimaculata*. The specimen, a female, was captured by Mr. Marshall at Malvern, near Durban, Aug. 12, 1896.
- 5A. One of the five *cenea* offspring with the chief spot of the fore-wing pale ochreous, bred from the *hippocoön* parent (Fig. 1). The date of pupation unnoted. The imago emerged Oct. 24.
5. Danaine model of the above (as regards the ochreous tint of the chief spot), from the same locality, viz. *Amauris echeria*. The specimen, a male, was captured by Mr. Marshall at Malvern, near Durban, Aug. 11, 1896.

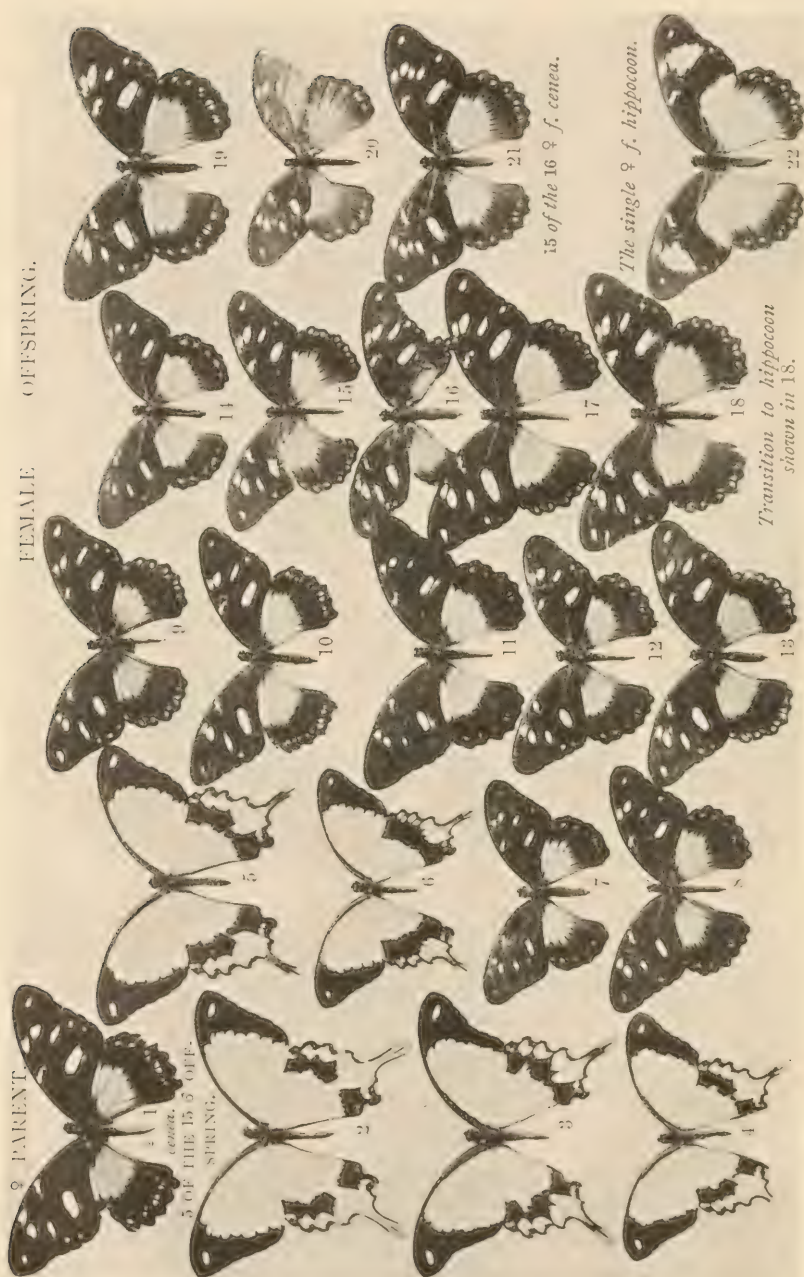


Mrs. P. P. Whelpley, pnx.

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All figures are about $\frac{2}{3}$ of the natural size.

Examples of the mimetic female forms of *Papilio dardanus*, subsp. *cenea*, bred in 1906 from a *hippocoon* form of female: Durban, Natal. The female parent and the Danaïne models from the same locality are also figured.



Alfred Robinson, phot.

Witherby & Co.

The females (except one) and a third of the males bred in 1907 from a *cenea* female f. of *Pap. daridius cenea*, Durham Natal.

EXPLANATION OF PLATE XXIV.

The female parent (*cenea* female form of *Papilio dardanus*, subsp. *cenea*) together with one-third of the males and the whole of the female offspring (except one greatly deformed *cenea*) bred from it by Mr. G. F. Leigh, at Durban.

All the figures are about $\frac{2}{3}$ of the natural size.

FIGS.

1. The female parent, captured Jan. 14, 1907, and laid 42 eggs Jan. 15 and 16. The spots (1)–(4) round the end of the fore-wing cell are well developed. The chief spot is pale ochreous, the others white. The spot (5) in the cell is divided into two. The hereditary transmission of these and other characters of the parent described on p. 438, may be traced in the *cenea* offspring Figs. 7–21.

The male offspring are shown in Figs. 2–6.

2. The example in which the submarginal black band of the hind-wing is least developed.
 3. The example which follows Fig. 2 when the specimens are arranged in the order of the increasing heaviness of the black band.
 4. After Fig. 3 succeed two unfigured specimens and then the example here represented.
 5. An unfigured example follows Fig. 4, and then the specimen here shown, which is succeeded by seven unfigured males.
 6. The seven specimens above referred to are followed by the male here represented,—the individual in which the band is blackest
- The female offspring of the *cenea* form are shown in Figs. 7–21.

These are fully described in the order of the figures on pages 440, 441.

- 7–13. The specimens shown in these seven figures possess the normal number of spots (1)–(4) in the fore-wing, resembling the parent in this respect, although in some of them the spots are smaller. The fore-wing spots in the specimen shown in Fig. 9 are more ochreous than in any other, the remaining 14 *cenea* offspring being in this respect nearly in the condition of the parent.

Explanation of Plate XXIV.

FIGS.

- 14—19. These specimens have an additional fore-wing spot (4a) beyond (4) and over the end of the cell. The normal spots (1)–(4) are fully developed in all except the example represented in Fig. 14. Fig. 18 shows a rather marked transition towards the *hippocoon* pattern, in the pale linear patch on the inner margin of the fore-wing and the extension downwards and outwards of the chief spot (1) in the same wing.
- 20, 21. These females have another additional fore-wing spot (2a), between (2) and (3).
22. The single *hippocoon* female form in this family. Spot (5) within the fore-wing cell is seen to be divided, as in the parent. A similar division of (5) is seen in many of the *cenea* offspring as described on pp. 440, 441.

XXI. *Mimetic North American species of the Genus Limenitis (s.l.) and their models.* By EDWARD B. POULTON, D.Sc., M.A., LL.D. (Princeton), F.R.S., etc., Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford.

[Read November 20th, 1907.]

PLATE XXV.

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INTRODUCTION.

THE mimetic species of the North American Nymphaline genus *Limenitis* (including *Basilarchia*) superficially resemble, in the east and north, as suggested by Doubleday (Gen. Diurn. Lep., ii, p. 275), models belonging to (1) the *Danainæ* and (2) the *Papilioninæ*: in the west (3) a Nymphaline model generally placed in the South American genus *Adelpha*, allied to *Limenitis*.

A species of *Limenitis*, in many respects relatively ancestral and probably resembling the form from which the mimics arose, still exists in the east, and another in the west. Hence the history of the transformation—probably in every case very recent—can be made out with exceptional clearness.

The subject will be treated in the order in which the models have been arranged above.

I desire to thank Dr. F. Du Cane Godman, F.R.S., for

kindly lending me the specimens represented in Figures 2 to 8 on Plate XXV, and the authorities of the British Museum of Natural History for the originals of Figures 1 and 10.

THE DANAINÉ INVASION OF THE NEW WORLD AND THE CONSEQUENT MODIFICATION OF NORTH AMERICAN SPECIES OF LIMENITIS.

One of the most interesting problems of mimicry and migration in butterflies is raised by the consideration of these North American Danainés. The genera to which they belong extend throughout the tropical New World, but, although represented by excessively abundant individuals, they enter into no synaposematic relations with any of the Neotropical combinations. They mimic nothing and nothing mimics them in tropical America. On the other hand, in North America they supply models for some of the very best examples of mimicry in the North temperate zone. Considering these facts, it is clear that a suggestion published by the present writer in 1901 is erroneous. *Anosia plexippus* (*archippus*, F.) cannot have had its ancestral home in South America or have invaded the northern belt from the immediate south. The argument founded on a supposed southern source is, however, unaffected and has so direct a bearing on a common hypothesis as to the origin of mimetic resemblances that I venture to quote it on the present occasion:—"In the New World the genus *Limenitis* is confined to the Nearctic Region with the exception of a single species, a form of the mimetic *L. astyanax* (Fabr.), which just enters the borders of Mexico. If butterfly colours and patterns are the expression of the direct influences of the environment, then it is clear that the indigenous non-mimetic species of *Limenitis* (*Basilarchia*) are an expression of Nearctic conditions, and according to the theory of External Causes, the invader from the South should have come to resemble them instead of drawing an ancient Nearctic species far away from the ancestral colours and patterns into a close superficial likeness to itself."* This argument is, as I have said, unaffected, because the Danainé is clearly an invader, although not from South America.

* "Verhandl. d. V. Internat. Zool. Congr. z. Berlin." Jena, 1902, p. 171.

The argument may be briefly recapitulated as follows:—

The fact that the distasteful foreign species, invading temperate North America from a very different area, should not only maintain their characteristic original appearance under such different conditions, but should compel the ancestral residents in their new home to resemble them, is entirely inconsistent with an interpretation of mimicry based upon the supposed influences of locality (soil, food, climate, etc.).

In attempting to make out the past history of the North American Danaines, it is of paramount importance to ascertain their affinity with the Old World species; for it is admitted that their relationship to all other New World genera is remote. Rothschild and Jordan have recently stated that *Tasitia* is inseparable from the genus *Danaida* (*Limnas*) which contains the well-known *chrysippus*, L., and its forms.* I therefore wrote to my friend Dr. Karl Jordan, enquiring whether he had considered the affinity of these forms to the New World *Anosia* and the Old World *Salatura*. He kindly replied as follows:—"I think that all the tawny Danaids [*Limnas*, *Salatura*, *Tasitia*, *Anosia*] are one genus, with the exception of the large [*Anosia*] *plexippus*. This insect differs as larva in having only two pairs of filaments † and as imago in the cell of the hind-wing being very long. The differences given by Moore for *Limnas*, *Tasitia* and *Salatura* do not at all hold good, neither the shape of the wings nor the position of the veins being constant."

Accepting this conclusion, the name *Anosia plexippus*, L. (*archippus*, F.), will be retained in the present memoir, while *berenice*, Cr., and its form *strigosa*, Bates, will be placed in the genus *Danaida*. It is impossible to speak with certainty as to the Old World species which most nearly represent the invading ancestors of the North American Danaines. A safe conclusion can only be arrived at after a searching investigation into the structural details of many species. But there can be little doubt that *Danaida* (*Salatura*) *genutia*, Cr. (*plexippus*, L.), presents many of the features of this ancestor. Thus the white markings upon the hind-wing under surface of *D. berenice*

* "*Danaida chrysippus* cannot be generically separated from the American *gilippus* and *berenice*, *Limnas* being a synonym pure and simple of *Tasitia*." Nov. Zool., vol. x, Dec. 1903, p. 502.

† See, however, the note on p. 488.

are practically identical with those of *genutia*. The distribution of the latter also favours the same conclusion, for it extends far beyond the tropics into Western and Central China.

Anosia is the outcome of a much earlier invasion, allowing time for modification and the acquisition of characters of generic rank in the new home. *Danaida berenice* is the result of a far more recent immigration. The Old World parents of the two American forms were probably closely allied or may even have belonged to the same species at different periods of its history. There is strong evidence in the mimicry of these two genera by species of *Limenitis* (*Basilarchia*) that the relative periods of residence in North America were as they have been indicated above. Details will be supplied in later pages. It will be sufficient to point out here that the evolution of *L. archippus*, Cr. (*misippus*, F.), from the characteristic type of Holarctic *Limenitis* presented by its ancestor *L. (B.) arthemis*, Drury, has involved an entire change to a new and highly elaborate pattern on both surfaces,—a process which even the most ardent mutationist can hardly conceive to have been a rapid one,—especially when the mimetic pattern hits off so precisely the characteristic details of the model. *Danaida berenice* has however merely modified into resemblance with itself—a likeness attained by a few simple but perfectly effective changes—the mimic already fully formed under the influence of *Anosia*. In fact, distinct and evident details of the earlier mimicry of *L. (B.) archippus* still persist, and somewhat detract from the mimetic resemblance attained by its descendant, *floridensis*, Streck. (*eros*, Edwards).

The effects produced by both Danaine models upon the butterfly fauna of North America, combined with the absence of such effects in the tropical New World, support the conclusion that residence in the north has been far longer than in the south, and that the south was reached by way of the north. It is probable that the Old World ancestor of *Anosia* spread northward along the eastern borders of Asia, and entered America by way of the Aleutian Islands, and that its astonishing northern range dates back to the period of the invasion. The ancestor of *Danaida berenice* may have followed the same route during some temporary amelioration of climate, enabling this more tropical form to reach its present home in the New

World. At the northern boundary of the Neotropical Region—now running east and west from Mexico City to points on the Atlantic and Pacific coasts considerably further north—the southward migration of both Danaines was probably checked for a considerable period. Held back for a time at the limits of that crowded area, teeming with the species of the allied *Ithomiinae*, they finally in comparatively recent times forced their way southward and spread through South America, even reaching, in the case of *Anosia*, the south temperate zone. All this has been so recent that only insignificant changes—probably sub-specific—have occurred, and no mimetic or synaposematic relationship has been formed.*

The hypothesis set forth above has the one merit that it accounts for the facts, puzzling as many of them are. The phenomena in the northern zone are unique, and as for those of the tropics, there is no other case where *Danainæ* of such marked size and appearance range through a crowded area without producing any effect on any member of the Lepidopterous fauna, or without themselves being affected thereby. If a striking comparison be desired, no better instance can be selected than the three African species of the genus *Melinda* (*Tirumala*), the products of an invasion from the Oriental Region. Of these three species *T. formosa*, Godm., and *T. mercedonia*, Karsch, are mimicked respectively by *Papilio rex*, Oberth., and its form *mimeticus*, Rothsch., while *T. morgeni*, Honrath, is itself mimetic of the characteristic Ethiopian Danaine genus *Amauris*.

It is, perhaps, unnecessary to state that in speaking of this Danaine invasion of tropical America, I leave out of account the remarkable *Danainæ* forming the section *Lycoræini*. These are at once shown by their structural peculiarities no less than by their intimate association with the great synaposematic groups to be very ancient inhabitants of the Neotropical Region.

THE EVOLUTION OF LIMENTIS (PASILARCHIA) ARCHIPPUS, Cr. (MISIPPUS, F.), AND ITS FORMS AS MIMICS OF THE INVADING DANAINES.

L. archippus is rightly considered by S. H. Scudder as the most striking example of mimicry in temperate North

* It is however possible that a large Peruvian form of *Actinote thalia*, L. (or *anteas*, Dbl., Hew., if these two forms can be kept distinct), is an incipient mimic of *Anosia*.

America (" Butterflies of the Eastern United States and Canada," Cambridge, Mass., 1889, p. 718). It is, indeed, one of the most striking in the world. Before describing the evolution of its pattern from that of the ancestral *L. arthemis* it will be convenient to compare the distribution, habits, etc., of the two species.

Limenitis archippus, Cr.—Scudder states that this species ranges nearly all over the United States as far west as the Sierra Nevada, and, in Oregon and British Colombia, to the Pacific. It is however rare in the west, and unknown in Colorado, Arizona and New Mexico. It extends from Hudson Bay in the north to the Gulf of Mexico in the south. It is thus " found over very nearly the same area as *Anosia* " (l. c., p. 278).

Scudder describes its flight as " rather leisurely and sailing " (l. c., p. 277). It frequents " open country in fields and meadows, especially in low ground." Comparing its relative numbers with those of its parent *artemis* and the sister species *astyanax*, Scudder states that *archippus* is " almost universally more numerous in individuals than the others " (l. c., p. 266). *Archippus* always appears to have two broods where the other two species usually have one.

The food-plants of the larva are willow and poplar, although many other plants are also recorded.

Limenitis arthemis, Drury.—Scudder speaks of this as a Canadian species *par excellence*, ranging over the whole width of Canada east of the Rockies, and far north to an unknown distance. It is also abundant in the north-eastern States.

Scudder describes its sailing flight (p. 304), also stating that " it is very active, and has a rather short and rapid flight " (p. 303).

The earlier stages of the two eastern and northern mimetic species of *Limenitis* and their non-mimetic ancestor are, according to Scudder, only distinguished with difficulty (p. 254). *Arthemis* and *astyanax*, F., are, however, as we should expect, even more closely similar than *artemis* and *archippus* (p. 255). The larva of *artemis* feeds on a great variety of plants, including willow and hawthorn.

THE EVIDENCE THAT LIMENITIS ARCHIPPUS OCCURS AT THE SAME TIME AND PLACE AS ITS MODEL.*

The following evidence (p. 455) bearing on the time and space relationships of *Limenitis archippus* and its Danaïne model exists in the bionomic series of the Hope Department. The most perfect data were those obtained on August 5, 1897, when, with my kind friends Professor W. M. Wheeler (now of Harvard) and Professor S. Watasé, I had an excellent opportunity of witnessing the flight of many examples of both model and mimic on the same ground.

One of the specimens, a female, captured on August 6, 1897, had evidently been visiting the flowers of the food-plant of its model; for abundant Asclepiad pollen-masses are attached to its limbs.

THE EVOLUTION OF THE MIMETIC PATTERN OF L. ARCHIPPUS FROM THAT OF THE NON-MIMETIC L. ARTEMIS.

In the following interesting passage Scudder discusses the general principles by which, as we may believe, this remarkable transformation was effected:—

“It is to be presumed that the actual colors found in a mimicking butterfly are, with rare exceptions, such as existed somewhere in the ancestral form. In the case of our own mimicking *Basilarchia*, for example, whose orange ground tint is so totally at variance with the general color of the other normal members of the group, it will be observed that all the normal species possess some orange. Without this as a precedent fact, such perfect mimicry might perhaps never have arisen. Individuals among the normal species vary somewhat in this particular, so that

* Much time and effort have been expended, during many years, in the Hope Department, to induce naturalists in the field to collect evidence bearing on the coincidence in time and space and on the habits of mimetic species and their models, to breed the seasonal forms of butterflies and accurately to record the times of their appearance in nature. Many of the results of this special study have been published. So far as I am aware, systematic attempts of the kind have been made by no other institution. I am bound to assume that the editor of “The Entomologist’s Record” is ignorant of facts well known to probably every other student of insects in this country. However this may be, any reader of that publication can judge for himself how far the statements and inferences on pp. 189, 190 of the July number are true or false.—E. B. P., July 27, 1908.

MODEL. <i>Anosia</i> <i>plexippus</i> .	MIMIC. <i>Limenitis</i> <i>archippus</i> .	LOCALITY.	CAPTOR AND DATE.
1	2 (with 2 <i>L. arthemis</i>)	W. Manitoba, Russell, July 6, 1897, about 1600 ft.	H. R. Smith. July 6, 1897.
2	3	W. Manitoba, about 1700 ft., 5 miles W. of Virden.	Miss Mary G. Holmes. July 5, 1898.
1	1	Ontario, Lake Sim- coe, De Grassi Point.	E. M. Walker. July 29, 1899.
1	—	Toronto, Golf Links, 5 miles E. of city.	E. B. Poulton. Sept. 23, 1897.
—	1	Toronto, Rose- dale.	E. B. Poulton. Aug. 25, 1897.
1 Aug. 19.	1 Aug. 27.	Northern Adiron- dacks, N.Y., Paul Smith's.	Rev. A. P. Hunt. 1903.
1 Aug. 17.	3 "Aug," Aug. 19 and 21	White Mountains, N.H., about 1800 ft., Colebrook, Parson's Farm.	Rev. A. P. Hunt. 1901.
5	2	Eastern States, probably Dublin, N.H.	Abbott H. Thayer. Probably Aug. 12, 1899.
3	5	Near Boston, Re- vere Beach.	Rev. A. P. Hunt. Aug. 2, 1901.
4 (including pair in cop.)	8	Chicago, waste land, S. of Jack- son Park.	S. Watasé. W. M. Wheeler. E. B. Poulton. Aug. 5, 1897.
—	2	Chicago, E. of Lake Calumet.	W. M. Wheeler. E. B. Poulton. Aug. 6, 1897.
1	1	Kansas, Topeka, near Rock Island, R. R. Bridge.	C. L. Pribble. June 10, 1900.

it is easy to suppose that some of the original archippus with more orange than usual may have escaped capture on occasion from this cause. From such a small beginning, such as one may now see every year in *B. astyanax*, sprang doubtless the whole story, and we now find a butterfly which has for a ground color of both surfaces of the wings an orange which is the exact counterpart of that of *Anosia plexippus*: by reason of which in all probability it enjoys a freedom from molestation comparable to that attributed to *plexippus*, so that it ventures more into the open country than its allies, and thus gains a wider pasturage and surer subsistence" (l. c., p. 714).

The attempt will now be made to give an account of the changes in detail by which the mimetic pattern has been evolved from the entirely different pattern of the non-mimetic ancestor. The changes are somewhat more complex and probably more important upon the under surface which will therefore be considered first.

a. *Hind-wing Under Surface of Limenitis archippus*.—The black outer border to the white discal band of the hind wing of *arthemis* persists in *archippus*, but is much displaced inwards as compared with its ancestor. The reason of this is evident. The character in *arthemis* which initiated the mimicry of *Anosia* is the submarginal row of reddish spots, commonly found in the hind-wing, more rarely in the fore. The enlargement of these, as well as of the black-and-white-marked margin (also in mimicry of *Anosia*), has involved the shifting inwards of the black outer border of the white band. In many specimens of *archippus*, traces of the white band of *arthemis* may still be found for a greater or less distance along the inner edge of the black discal line. This vestige is especially often retained along the costal half of the line: it is occasionally well developed along its whole length. The original submarginal red spots are still recognizable between the discal line and the margin, being easily distinguishable by their deeper richer tint from the pale ground colour of the wing.

The black margin has become heavier, the double row of blue crescentic spots larger and whiter, but a faded trace of the original blue tint of *arthemis* can still be made out in the spots of the inner row, and remains distinct in the outer.

The basal red patches have vanished, but the pale blue

marks in and on the costal side of the base of the cell are retained, and, lightened in tint, represent the two more conspicuous white spots occupying nearly the same position in *Anosia*.

These changes, together with the transformation of a dark chocolate-brown ground-colour into a pale yellowish tint are the means by which the hind-wing under surface of the non-mimetic ancestral *arthemis* has become that of its beautifully-mimetic descendant, *archippus*.

b. *Fore-wing Under Surface of Limnitis archippus*.—The changes on the under surface of the fore-wing must now be considered. In *arthemis* the angulated black line, bordering the outer edge of the white discal band, runs from the costa to the anal angle of the wing. In *archippus* its anal extremity has been shifted upwards until it now joins the hind margin about at the junction of its middle and anal thirds. Rendered far more conspicuous against the ground-colour, greatly expanded at its costal end and there enclosing from two to four white spots, vestiges of the outer part of the white band, the marking now adds greatly to the mimetic resemblance, by its likeness to the subapical pale-spotted black band of *Anosia*. A further trace of the white band is generally seen on the costa itself, here often persisting for a distance equal to the normal width of the marking in *arthemis*. This character has also probably been retained because of its resemblance to the costal white markings of *Anosia*.

The two deep reddish patches in the cell of *arthemis* have disappeared in *archippus*, converted, with the ground-colour around them, into a fulvous tint considerably darker, as in the model, than that of the hind-wing and the apical region of the fore. Between these red patches in *arthemis* is a variable bluish triangular mark often pupilled with white and often surrounded by a black border. Other even more variable markings of the same kind are seen in the base of the cell. Although the red spots have disappeared in *archippus* the outer of these pale marks is, together with its black margin, almost always retained of full size but whiter than in *arthemis*. A trace of the basal mark or marks is also generally to be seen, sometimes only in the form of the black margin including a few pale bluish scales. This feature persists in a more complete state in the female specimens I have had the opportunity of examining. The outermost triangular pale mark, in spite

of its far more isolated position, probably represents a white spot, also triangular in shape, near the end of the cell in *Anosia*.

The marginal pattern is as in the hind-wing save that the apical white spots of the innermost series lose the crescentic shape and become squarish. The changes which have occurred in the subapical white spots of *arthemis* are peculiarly interesting. In *archippus*, only the costal spot and the second minute spot, generally a mere point, remain distinct and clear as in the ancestral form. The others—one to three in number—have become continuous with and contribute to form the triangular subapical pale yellowish patch which, in both mimic and model, is of the same tint as the ground-colour of the hind-wing. In the *Limenitis*, however, the outer (hind-marginal) part of this pale patch exhibits, as in the hind-wing, by a deeper tint, a distinct vestige of the reddish submarginal spots of *arthemis*. The single distinct costal white spot and minute second spot already referred to, appear to represent the extremity of a sickle-like curve within the apical angle of the fore-wing. All other parts of this curve are made up of the innermost series of marginal white spots—the ones which have undergone the principal increase in size in *archippus*. The effect is heightened by the special enlargement of the apical spot itself. Now when we turn to the model we find that the innermost series of marginal white spots does actually turn inwards sickle-like within the apex and that a close superficial resemblance has been attained in the mimic by the fusion of two separate elements. One of these has been preserved for the purpose out of an ancestral marking of which the remainder has been transformed in an entirely different direction.

The utilisation of the chief black and white markings of *arthemis* in the subapical region of the fore-wing of *archippus*, in order to promote the mimetic resemblance to *pleippus*, together with the value of the whitened marginal lunules of both wings is fully recognised by Scudder (l. c., p. 278).

c. *The Upper Surface of Limenitis archippus*.—The marginal band is much blacker and heavier looking than that of the under surface, in correspondence with the *Anosia* model. The markings in it consist only of the white sections of the fringe and the spots of the innermost series, the outer blue crescentic marks in the margin of *arthemis* having disappeared. The innermost crescents have become white and

in many individuals of *archippus* have lost their original form and gained a rounded shape. They often tend, as in the model, to be more strongly developed in the anal part of the series. Clear evidence of selection is seen in the relation between the degree of development of the black, white-marked marginal pattern in fore- and hind-wing of *arthemis* and *archippus* respectively. In *arthemis* this pattern is far more developed in the hind-wing than the fore, a condition reversed in *archippus* in accordance with the pattern of its model. A sickle-like curve is developed within the apex of the fore-wing in the same manner but not so fully as on the under surface.

The black outer border of the white discal band persists but is less heavy than on the under side. As on the latter surface it seriously interferes with the likeness to *Anosia* on the hind-wing, but enters into the mimetic pattern on the fore. Vestiges of the white discal band were not found on the upper surface of the hind-wing in any of the numerous specimens I have examined (although occurring in the form *hulsti*, Edw.); nor was the black band entirely wanting from any. A variety without this latter marking is however known and has been described as *pseudodorippus*, Strecker. The type of this form exists in Dr. W. J. Holland's collection ("Butterfly Book," New York, 1899, p. 185). On the fore-wing, vestiges of the white band persist and enter into the mimetic pattern, but they are far more reduced than on the under surface, in correspondence with the fact that many of the orange apical spots on the upper surface of the model are represented by white on its under surface.

The triangular pale spot in the cell of the fore-wing is usually represented on the upper surface by its black border only, but in a considerable proportion of individuals the white centre persists in a conspicuous form. In many individuals of the ancestral *arthemis* the same marking appears on the upper surface as a white point, generally very minute and often developed unequally on the two sides.

d. *The white spots on Body and Appendages of Limenitis archippus*.—There appears to be great variation in *arthemis* in the development of these pale spots and markings, but there is no doubt about their great increase in size and brilliancy in *archippus* and conversely their great reduction in *astyanax*. Pale spots corresponding to the brilliant white marks of *archippus* are always to be found in some

individuals of *arthemis*. This development in the mimic of course corresponds to the conspicuous body and leg pattern of the Danaïne model.

LIMENITIS ARCHIPPUS, F. HULSTI, EDW., A BETTER MIMIC THAN ARCHIPPUS ITSELF.—In this Arizona and Utah form, as described and figured by Dr. W. J. Holland ("Butterfly Book," pp. 84, 185, Pl. VII, fig. 5), the black discal band on the hind-wing upper surface is evanescent, although distinct traces of the white band persist as a series of internervular spots. I have not had the opportunity of examining the under surface pattern. Dr. Holland states that the species occurs in Arizona with *Danaïda berenice* and its form *strigosa*, Bates, and that it more closely resembles the latter. It is not unlikely that the vestiges of the white band on the hind-wings may, when the insect is on the wing, conduce towards a general likeness to the pale-streaked hind-wings of *strigosa*. Dr. Holland's figure indicates that, in the reduction of the subapical black of the fore-wing and the appearance of the associated white spots, *hulsti* has been modified from mimicry of the *Anosia* into resemblance to *Danaïda*. Dr. Holland also draws attention to the dull tint of its ground colour as compared with *Limnitis archippus*, another change in the same direction.

LIMENITIS ARCHIPPUS, F. FLORIDENSIS, STRECKER (EROS, EDWARDS), A MIMIC OF DANAIDA BERENICE.

This example of mimicry is nearly as well known as that of *archippus* for *Anosia* (see e. g. Scudder, l. c., p. 718). At the same time, so far as I am aware no attempt has been made to compare the details of the resemblance in the two mimics in relation to the patterns of their respective models.

That *floridensis*, Streck., is a modification of *archippus*, under the influence of a second Danaïne model (*berenice*), and is not the result of an independent evolution from *arthemis*, is at once evident from the persistence in it of features which are truly mimetic in *archippus* but tend to interfere with the resemblance to the existing Danaïne model. Such features are seen on the upper surface, in the heavily blackened veins, and the large black triangular subapical markings on the fore-wing, as well as in the corresponding markings on the under surface. These features are, however, greatly obscured by the deepening of the ground colour into a dark mahogany-brown, like

that of the Danaïne model. For the same reason the black margin is wider on both surfaces than in *archippus*. On the upper surface the white spots in the margin are much reduced and the white sections of the fringe slightly so, while on the under these markings remain conspicuous and distinct, much as in *archippus*. The sickle-like curve of white spots is seen at the apex of the fore-wing in *berenice*, and this feature is represented in *floridensis* in the same manner as in *archippus*. On the under surface the hind-wing of the Danaïne is strongly veined so that the original mimetic feature of *archippus* holds good for the new model. This is not the case in the fore-wing where it detracts from the resemblance. The darkening of the ground colour of the under surface of *floridensis* is especially remarkable because here the more ancestral mimic had acquired so pale a tint, in mimicry of *Anosia* which has an under side far paler than its upper. In *berenice*, on the other hand, the tints of upper and under surface are approximately the same. Against this dark ground all the white markings stand out far more prominently in both model and mimic than in *Anosia* and *archippus*. The basal costal light mark of the fore-wing under surface is more uniformly distinct in the few specimens of *floridensis* I have seen than in those of *archippus*; and the white spots bordering the black discal line of the hind-wing under surface are also more developed and certainly more distinct, being in fact often given a clear outline by means of a black margin on their inner edges. Here we have evidently the emphasis and in a sense the re-call of a vanishing character in consequence of the conspicuous spots around the end of the cell in the hind-wing under side of the new model, *berenice*.

Scudder describes the form *floridensis* (*eros*) as ranging into the Mississippi valley and Dakota, far beyond the limits of its Danaïne model. It would be very interesting to know the proportionate numbers of such specimens and to compare them with those from Florida, and ascertain whether the mimetic resemblance is in any way affected. Hitherto I have only had the opportunity of examining specimens from Florida.

In addition to the differences in pattern which distinguish *floridensis* from *archippus*, Dr. W. J. Holland states that the former is generally the larger (l. c., p. 186), and this is the case with the specimens I have studied.

THE PAPILIONINE MODELS OF LIMENITIS
ASTYANAX.

Before considering the evolution of *astyanax* from *arthemis* it is expedient to deal with the models, which in this case are Papilionine and not Danaïne.

The late Erich Haase ("Researches on Mimicry," part ii, Stuttgart, 1896, English translation) discovered the wide extent of mimicry within the *Papilioninæ*, showing that the section to which he gave the name of *Pharmacophagus* tended to supply models for his two other sections of the *Papilioninæ*,—*Papilio* (of which *machaon*, L., may be taken as a type) and *Cosmodesmus* (of which *podalirius*, L., may be taken as a type). He showed that this is true of both areas inhabited by *Pharmacophagus*—the New World, and, in the Old, the Australian and Oriental Regions, and the parts of the Palearctic adjoining the latter. Outside these areas *Pharmacophagus* is only represented by the single species *antenor*, Drury, of Madagascar. Rothschild and Jordan in their recent exhaustive and admirable monograph on the American Papilios (Nov. Zool., xiii, 1906, p. 411–752) entirely confirm Haase's triple division of the *Papilioninæ* and show the numerous mistakes that have been made by systematists in inferring relationship from the superficial resemblances due to mimicry.

Haase failed, however, to appreciate the true nature of some of these mimetic associations because of his imperfect recognition of the scope of the Müllerian principle. He failed to do so in the case of the models of *astyanax*. As in other examples, Haase regarded the distasteful Central and North American "*Aristolochia* Swallowtail" (to use Rothschild and Jordan's term), *Pharmacophagus philenor*, L., as the central model round which were clustered species of his section "*Papilio*" as well as the Nymphalines, *Limenitis astyanax* and the female of *Argynnis* (*Semnopsepsyche*) *diana*, Cr.*

But the resemblance of these two Nymphalines to the primary model *philenor* is so poor that the suggestion is

* The mimetic resemblance of the dark southern ♀ form of *Papilio glaucus* (*turnus*) to *P. philenor* is also mentioned by A. R. Wallace ("Darwinism," London, 1889, p. 248) and Weismann ("The Evolution Theory," 1904, English translation, i, pp. 110, 111). Wallace also (l. c.) speaks of the likeness of *Limenitis ursula* (*astyanax*) to *philenor*.

unconvincing, and most naturalists will agree with Scudder in his hesitation in accepting it. At the same time, Scudder points out that the female *Argynnis* is an undoubted mimic of the *Limenitis*, but he, also failing to recognise the scope of the Müllerian principle, was only puzzled by the fact.

In the following pages it will be argued that *philenor* is the central primary model mimicked by both sexes of *Papilio troilus*, L., by the female and on the under surface by the male of *P. asterius*, Cr., and by the dark female form (*tirinus*, L.) of *P. glaucus*, L., but that strong secondary resemblances exist between these three mimics, rendering them far more like each other than they are to the primary model; that the *Limenitis* is a secondary mimic of these three mimics, and the female *Argynnis* a tertiary mimic, perhaps a Batesian mimic, of the *Limenitis*.

THE GEOGRAPHICAL DISTRIBUTION OF PAPILIO (PHARMACOPHAGUS) PHILENOR AND ITS PRIMARY, SECONDARY AND TERTIARY MIMICS.

The distribution of the *Papilioninæ* is taken from Rothschild and Jordan's account, that of the *Nymphaliniæ* from Scudder's.

Papilio philenor, L.

Distribution. Mexico and the United States, except the central district from Colorado northwards; in Southern Canada and New England as a straggler.

In the subspecies *orsua*, Rothsch. and Jord., from the Tres Marias Islands, the tail of the hind-wing is represented by a tooth-like projection and the glossy area on the hind-wing upper surface is more extensive and more brilliant.

The larvæ of *philenor* are gregarious when young and semi-gregarious later in life (Scudder, p. 1248-9). The perfect insect is very tenacious of life, and Edwards states that it has a strong and disagreeable scent.

The three *Papilionine* mimics are placed by Rothschild and Jordan in three different groups of the section "*Papilio*," Haase ("Fluted Swallowtails," Rothsch. and Jord.).

V. MACHAON GROUP.

60 c. *P. polyxenes asterius*, Cram.

South and north, from Honduras to Canada: west and east, from Arizona and the Mississippi basin to the Atlantic. Females mimetic throughout the range. Males mimetic on under surface, but non-mimetic on upper except the form *ampliata*, Ménétr., common at Guerrero, México. Intermediates between *ampliata* and the males with non-mimetic upper surface are also common in the same locality.

60 a. *P. polyxenes americanus*, Kollar, from N. Peru to Colombia and Venezuela, also has a dark form of both sexes, *melasina*, Rothsch. and Jord., with all inter-gradations between it and the light type form. The special mimetic features of the female *asterius* are not developed in this dark form, which is of great interest in helping us to understand the evolution of the northern mimic from a comparatively simple melanic variety.

The larva of *asterius* is said to resemble that of *Anosia plexippus* (Scudder, l. c., p. 747).

VIA. GLAUCUS GROUP.

In Rothschild and Jordan's memoir two consecutive groups, of which this is the second, are both accidentally numbered VI. I have therefore called this VIA.

79 a. *P. glaucus glaucus*, L.

Atlantic district, from Florida to New England, and westward to Mississippi basin. The female form *glaucus* resembling the male is the ordinary one in the northern districts, while the mimetic form *turnus* is commoner than it in the southern. Intermediates occur but are rare.

79 b. *P. glaucus canadensis*, Rothsch. and Jord.

Newfoundland, Anticosti, New Brunswick, Canada to the north of British Columbia and Alaska. The females resemble the males, and mimetic forms are unknown in this subspecies, and the other species of the group.

VII. TROILUS GROUP.

Allied to the highly mimetic ANCHISIADES GROUP, with gregarious larvæ.

Contains only two species, of which one is mimetic and the other probably non-mimetic, although incipient mimicry is possible on the under surface.

85 a. *P. troilus troilus*, L.

From Georgia to Canada: westward to Texas and the Mississippi plains: north-westward to N.W. territory of Canada.

85 b. *P. troilus texanus*, Ehrm.

Florida, in spite of the name. Probably a more primitive form in which the mimetic resemblance is less advanced than in 85 a.

86 a. *P. palamedes palamedes*, Drury.

Florida to Philadelphia, and westward to Mississippi plains.

86 b. *P. palamedes leontis*, Rothsch. and Jord.

A small form. Monterey, Mexico.

Limenitis astyanax.—The distribution is thus given by Scudder:—"It ranges from the Atlantic westward to the Mississippi Valley, and from the Gulf of Mexico northward to about the 43rd parallel of latitude." A closely allied species or more probably a form of the same species is recorded by Godman and Salvin from Mexico.

Argynnis (Semnopsyche) diana, Cr.—Scudder describes the distribution of this species as follows:—"An inhabitant of the hilly country of the south, following the Alleghanies, and a comparatively narrow belt westward at about the 38th parallel of latitude." How far westward it extends is unknown (p. 1801.)

The account given above shows that there is a very close coincidence between the distributional areas of the six species. When the area is comparatively restricted, as in the case of *A. diana*, it is still, as Scudder points out, altogether included within that of the species which its female most closely resembles, viz. *Limenitis astyanax*.

THE EVIDENCE THAT PAPILIO PHILENOR AND ITS MIMICS OCCUR AT THE SAME PLACE AND TIME. There is unfortunately at present far too little evidence on this subject. The small amount of material in the bionomic series of the Hope Department is tabulated below.

<i>Phileas.</i>	<i>Trochus.</i>	<i>Asterias.</i>	<i>Glaucus.</i>	LOCALITY.	CAPTOR AND DATE.
1 ♂ 58th Street, near the University.	1 ♀ 59th Street, near the University.	1 ♀ Jackson Park, the Island. July 28.	1 ♂ 59th Street, near Hotel del Prado.	Chicago.	E. B. Poulton. Aug. 10, 1897. Except <i>asterius</i> .
1 ♂ 58th Street, near Woodlawn Avenue.					
1 ♂ Aug. 1901.*	2 ♂ 1 ♀ Aug. 9. 1 ♂ Aug. 24.	1 ♀ Aug. 9.	—	Rutherford, N. J.	J. Cook. 1902.
3 ♂	—	1 ♂	—	Arizona, S. bound- ary of, Nogales.	R. C. L. Perkins. April, 1897.

* Probably a slip for 1902. The specimen has no original label upon it.

With regard to *Argynnis diana* I have no further information, but there is evidence that *L. astyanax* occurs with the *Papilios*. Thus Scudder states (p. 287) that it is persecuted by *Papilio asterius*. It is possible that, as in other cases which have been observed, the male *asterius* may pursue *astyanax* in mistake for its own female. Professor Bateson has informed me that he took *astyanax* with at least one of the above-named *Papilios* (probably *P. troilus*) and that he was greatly impressed with their resemblance in the field. In fact, if I understood him rightly, his general impression at the time was that he was observing a single species. Mr. J. C. Moulton has recently shown me six specimens of *astyanax* and one of the *turnus* female of *P. glaucus*, from a small collection of butterflies recently made at Sioux, Iowa, by Mr. C. H. Griffith.

THE RELATION OF THE TURNUS FEMALE OF PAPILIO
GLAUCUS TO (1) THE PRIMARY MODEL, *P. PHILENOR*;
(2) ITS CO-MIMICS IN THE PAPILIONINÆ.

At first sight the under surface of the dark southern mimetic female of *P. turnus* appears to be little more than that of a melanic variety in which the characteristic black markings of the fore-wing can be seen in deeper pigment than the ground colour. A remarkable feature is the persistence of a pale patch of ground colour just inside the end of the cell. In the non-mimetic females this very patch is more or less cut off by dark pigment from the rest of the pale ground colour, and it is an interesting fact that the isolated ground colour should remain pale while the rest has darkened. When the details of the mimetic resemblance are examined it is at once seen that the form *turnus* is far more than a mere melanic transformation of the female *glaucus*. There is a persistence of every element that aids in the superficial resemblance to the co-mimics and to the central model, *philenor*:—the marginal and submarginal series of yellow markings of the fore-wing, and the yellow marginal and deep orange submarginal series of the hind-wing, and between these two series the great intensification of bluish-green, margined internally with bright blue.

On the upper surface of *turnus* the adaptive nature of the transformation is even more evident. The blackness here is far more intense than on the under surface, and obliterates all the black markings of *glaucus*, any of which

would interfere with the mimetic resemblance to *philenor*. On the surface of the hind-wing the melanic transformation is accompanied by a great development of the iridescent blue scales, extending inwards into the cell, and also upwards to the costa and beyond into the neighbourhood of the anal angle of the fore-wing. In the few specimens I have had the opportunity of examining the colour of these scattered scales was bright blue and not bluish-green as in the submarginal region of the under surface. The yellow marginal and submarginal markings of the upper surface remain and contribute towards the resemblance to *philenor*, although the submarginal series is much nearer to the border of the wing than in the primary model. As regards the yellow colour, the *turnus* form is the least perfect of the three Papilionine mimics; for the submarginal spots of *troilus* (although yellow in the more ancestral non-mimetic *palamedes*) have gained a peculiar bluish-green colour in mimicry of *philenor*, while those of the female *asterius* have undergone a slight modification in the same direction.

In another very important element, however, the under surface of the *turnus* female is far nearer to *philenor* than are any of the other Papilionine mimics:—the existence of a single instead of a double row of bright orange-red submarginal spots on the hind-wing, although these are much closer to the margin of the wing than in the primary model. On the other hand, a second inner row of such spots is not present in the male or the ancestral female which resembles it. In the position of this inner row four wedge-shaped dull red marks are to be seen in the ancestral pattern, and the persistence of these, intensified by contrast with the dark ground colour, in the *turnus* form, is probably related to the presence of the inner row in *asterius* and *troilus*. They certainly interfere with the resemblance to *philenor*.

Each of the first four orange spots (counting from the costa) on the hind-wing under surface of *philenor* is edged with glistening white on the side towards the apical angle of the wing, the fifth is edged on both sides, the sixth towards the anal angle but not on the other side, while the seventh is not edged at all. In this respect the pattern of *turnus*, although by no means identical with *philenor*, approaches the latter more closely than do any of the other Papilionine mimics.

As regards the blue-edged green iridescence, the hind-wing under surface of *turnus* much resembles that of the female *asterius*. On the upper surface of the same wing the limitation of the submarginal blue iridescent scales by a black line (representing the inner boundary of the heavy black submarginal band of *glaucus*) also strongly suggests the female *asterius*, while the development of blue iridescence over the disc of the wing beyond this limit resembles *troilus*. The female of *asterius* is characterised by the absence of iridescence on the basal side of a black line corresponding to the limit above described. In place of the discal iridescence there usually appears on the hind-wing of the female *asterius* a more or less well-preserved vestige of the conspicuous yellow band of the male, extending, although in a less developed state, into the fore-wing. These features render the female *asterius* a less perfect mimic of *philenor* than are the other Papilios, although in the fore-wing of the male *troilus* a corresponding band is generally found, but in a far more vestigial condition. On the under side of the fore-wing in both sexes of this species as well as of the female *asterius*, this same band is far more evident, but undoubtedly concealed in the natural position of rest.

SECONDARY MIMETIC RESEMBLANCES BETWEEN THE THREE PAPILIONINE MIMICS OF P. PHILENOR.

The resemblance between these three mimics is stronger and more evident than might be inferred from the comparison of details contained in the last section. The dominant element in this secondary resemblance is the character of the blue and greenish tints on both surfaces. These in all the mimics present an appearance markedly different from that of the primary model, *philenor*, with its brilliant steely lustre. The remarkable likeness between the two rows of orange-red spots on the under side of the hind-wing in *asterius* and *troilus* is another important point, as also the fact that the female form *turnus* is prevented from being a mere melanic form of *glaucus* not only in details which resemble the primary model but in those which resemble its co-mimics. Upon the wing or even at rest from a little distance, all three mimetic Papilios would present the closest likeness to one another.

The larger of the two red spots near the anal angle of

the hind-wing upper surface in the *turnus* female is in nearly the same position as the one conspicuous spot of *asterius* and *troilus*, while at the apical angle of the same surface of the same wing, a large red spot appears in *turnus* and *troilus*. Red spots are not found in either position on the upper surface of *philenor*. These spots are certainly ancestral in the *turnus* female, inasmuch as they are present in the non-mimetic female form and the non-mimetic male of the same species, as well as in the allied non-mimetic species. For the same reason the black-pupilled red spot at the anal angle of *asterius* is ancestral. In *troilus*, on the other hand, both red spots are probably of recent origin on the upper surface, and have been developed in relation with the mimetic appearance. They are yellow in the ancestral *palamedes*. It is probable that their red colour in *troilus* has been developed in secondary mimicry of *asterius* and the *turnus* female form of *glaucus*. It is in accordance with this interpretation that the red spot at the anal angle of *troilus*, although without the black pupil, bears considerable superficial resemblance to that of *asterius*, and that the red spot at the apical angle is especially well developed in the female.

The comparison of these three mimetic forms also yields evidence of an approach towards the primary model, in which the different species have made different rates of progress, presumably determined in large part by the age of the mimetic resemblance.

Papilio troilus is evidently the oldest mimic. The mimetic likeness, extending to both sexes, has been derived from a very different appearance still preserved in *palamedes*. The suppression in *troilus* of the fifth orange-red spot of the inner row of *palamedes* is apparently an advance in the direction of the open loop of spots which is the prominent feature in the hind-wing under surface of *philenor*. Equally clear advance is seen in the bluish tint which the submarginal yellow spots of the upper surface of *palamedes* have gained in *troilus*.

Papilio polyxenes asterius is less perfect and presumably less old as a mimic than *troilus*. The mimetic resemblance is found on the under surface of both sexes, but on the upper the male, if a mimic at all, has only reached an early stage in the resemblance. The evolution of the two rows of definite orange-red spots out of the ill-defined elements found in the non-mimetic ancestors, was probably

effected under the influence of *troilus*. The ancestral yellow submarginal spots have darkened, but to a far less extent than in *troilus*.

Finally in the *turnus* form of the female *Papilio glaucus*, only found in a certain proportion of the females in the southern part of the range, we have the youngest of these mimics. The mimetic resemblance is in some respects less perfect than in the other two *Papilios*, but, as regards the red spots of the hind-wing under surface, it has been already shown that this form presents the closest likeness of the three.

THE EVOLUTION OF THE MIMETIC PATTERN OF LIMENITIS
(BASILARCHIA) ASTYANAX FROM THAT OF THE NON-
MIMETIC L. ARTHEMIS.

As regards the upper surface of *astyanax* the main and almost the only difference from *arthemis* consists in the disappearance of the white band of both wings, together with all but a trace of the subapical white markings of the fore-wing, and the spreading of an iridescent blue or greenish tint over and within the area formerly occupied by the band. Towards its inner limits the iridescent tint fades gradually into the dark ground colour of the wings. The iridescence is clearly an extension of the colouring seen in the marginal markings of *arthemis*. The dimorphism in tint—blue or greenish—is characteristic of the ancestral form no less than of its descendant. The reddish submarginal spots commonly seen on the hind wings of *arthemis* are rarer and far less developed in the specimens of *astyanax* which I have seen. The converse relationship holds in the fore-wings, where however the red spots are less developed in *astyanax* than in the hind-wing of *arthemis*.

Upon the under surface the changes are greater; for not only is there a similar disappearance in *astyanax* of the white markings of *arthemis*, but the whole ground colour has become of an iridescent dark greenish-brown, against which the reddish spots near the base of both wings and in their submarginal region, show up very prominently. Although from this cause far more conspicuous, the submarginal red spots of the hind-wing have become greatly reduced in *astyanax*, in correspondence with the increase in size of the crescentic black and

iridescent markings lying immediately external to them, and forming an elaborate marginal pattern. It is to be observed that in *arthemis* itself the tint of the ground colour of the under surface and consequently the degree of prominence of the reddish spots varies very greatly, and that therefore an important element in the change from the ancestral to this mimetic form was pre-existent in the parent species and ready for selection to seize upon.

Passing to a very different relationship between the two species, the flight of *astyanax* is described as similar to that of *arthemis*, but still more lofty and grand, more leisurely and sweeping. (Scudder, p. 287.)

L. ASTYANAX A SECONDARY MIMIC OF THE PAPILIO MIMICS OF PHILENOR.

Passing now to the mimetic relationships of *astyanax*, there can be no doubt that the iridescent blue or greenish of its upper surface resembles that of the Papilionine mimics rather than the primary *Pharmacophagus* model, although it approaches the brilliant steely lustre of the latter somewhat more closely than do the secondary mimics. Of all the three mimetic Papilios, *astyanax* chiefly resembles *troilus*, in which the submarginal crescentic spots are blue or greenish, instead of dull yellow as in the female *asterius*, or bright yellow as in the *turnus* female of *glaucus*. On the other hand, neglecting this feature, the blue varieties of *astyanax* would most closely resemble this latter form. These same blue iridescent examples of the *Limenitis* also resemble the females of *troilus*, in which the black ground colour is powdered with iridescent blue scales, forming a crescentic band inside the submarginal greenish spots. The greenish forms of *astyanax* similarly resemble the male *troilus* in which the iridescence is of a peculiar greenish-grey.

As regards the hind-wing under surface, the submarginal reddish spots of *astyanax* resemble those of the *turnus* female of *glaucus* less distantly than those of the other Papilios. But the resemblance to any of the three is in this respect only feeble. The basal reddish spots of *astyanax* may however, with the submarginal series, give something of the effect of the double row of the other two Papilios, or perhaps in the attitude of repose the basal and submarginal reddish spots of the *Limenitis* may be

to some extent joined up by those of the fore-wing under surface, forming a loop roughly suggestive of *philenor*.

Scudder regards *astyanax* as a very weak and perhaps incipient mimic of *Papilio* (*Laertias*) *philenor* (p. 287). Had the conception of secondary mimicry been before him, Scudder would have recognised that, although *astyanax* is, as he states, but a poor mimic of the primary model, *philenor*, it bears a considerable superficial likeness to the three Papilionine mimics of this species.

TRANSITION BETWEEN ARTHEMIS AND ASTYANAX.—

The intermediate form *proserpina* is considered by Scudder (l. c., p. 289) to be a hybrid between *arthemis* and *astyanax*. In support of this conclusion he brings forward strong evidence based on distribution. *Proserpina* is found in a narrow belt across the eastern third of the continent, this belt coinciding with the southern boundary of *arthemis* and the northern of *astyanax*. Along this line it is known to occur at many points. *Proserpina* tends itself to vary in the direction of *arthemis* to the north and of *astyanax* to the south. The fact that Edwards bred *arthemis* and *proserpina* from the eggs of the latter is consistent with the view that the parent was a heterozygote (hybrid), whose offspring were yielding parent forms and heterozygotes, perhaps in Mendelian proportions.

In the collection of the British Museum *astyanax* and *proserpina* are regarded as forms or subspecies of *arthemis*, the form *lamina* of the latter supplying the connecting link.

TRANSITION BETWEEN ASTYANAX AND ARCHIPPUS.—

Hybrids between these two forms are considered probable by Scudder (l. c., p. 283). Thus he quotes Meade (Can. Ent. iv, p. 217) "who found an *astyanax* on whose upper surface the blue was supplanted by fulvous 'except in the marginal lunules, which are white with a faint bluish tinge.'" He also refers to Grey (*Ibid.* xi, 17) for "a melanitic form of *disippus* [*archippus*] with all the markings of *ursula* [*astyanax*] on the under surface." Professor Bateson has kindly called my attention to further notes on such intermediates, with figures, in "Psyche" (1904, Feb., and 1907, Oct.).

It is therefore probable that occasional interbreeding takes place between *astyanax* and *archippus*, and that

hybrid offspring are produced. If this be so it would constitute further evidence of the close affinity between these three forms, and of the recent operations of the selective processes by which the two mimics have been derived from their non-mimetic ancestor.

ARGYNNIS (SEMNOPSYCHE) DIANA (FEMALE) A TERTIARY MIMIC OF LIMENITIS ASTYANAX.—This interesting case of mimicry was, so far as I am aware, first suggested by Scudder, who was much puzzled by it. This distinguished authority remarks concerning *diana* that although it belongs to a group remarkable for resemblance between the sexes, its sexes are more strongly contrasted than those of perhaps any other butterfly in North America. "This difference, as we have pointed out in the body of this work, is a clear case of parastatic mimicry, the mimicry affecting the female only (as most in need of such protection), and is the more surprising since the butterfly mimicked belongs to the only genus in our fauna, where, in other species, parastatic mimicry of a Euploid butterfly occurs. If a butterfly of the genus *Basilarchia* needs protection and gains it by mimicry of *Anosia* or *Tasitia*, why should *Semnopsyche* take to imitating a normal *Basilarchia*? That it does closely resemble it any one can see, and the following passage from Edwards, writing of the discovery of the female, may be taken in evidence: 'While breaking my way through a dense thicket of [iron-weed], hoping to find another *diana* [male], I came suddenly upon a large black and blue butterfly, feeding so quietly as to allow me to stand near it some seconds and watch its motions. It seemed to be a new species of *Limenitis* [*Basilarchia*], allied to *ursula* [*astyanax*], which it resembled in color.' It may also be pointed out that its range is altogether included within that of *Basilarchia astyanax*" (l. c., p. 1802). Although the obvious interpretation of this interesting resemblance on the probable hypothesis that *Limenitis* (*Basilarchia*) is a distasteful genus and its mimicry of *Anosia* Müllerian, seems to have escaped Scudder in this passage and on p. 718, he elsewhere suggests (on p. 266) that *astyanax* may be specially protected:—"It is indeed possible that one of the normally colored species of *Basilarchia*, one that has least conspicuously contrasted colors, though resplendent with blue and green, is specially protected by the various

other devices we have recounted; for certainly it is itself mimicked by one sex of a butterfly of another very distinct group, viz. *Semnopsyche diana*."

The female of *A. diana* is only mimetic of *astyanax* on the upper surface. There is, however, far less sheen about the blue tint of *diana*, and in this respect it approaches the *Papilio* mimics of *philenor* more closely than it does *astyanax*, while the *Argynnis* is itself further removed from the primary model than any of the other mimics. Scudder speaks of the uniformity between the sexes of the group to which *diana* belongs; but Dr. F. A. Dixey has shown (Trans. Ent. Soc. Lond., 1890, pp. 89-129) that the females of *Argynnis* often tend to be dark, and he points to *A. paphia* as a well-known example of a species with a dark female form,—*valezina*. He gives strong reasons for the belief that such dark forms are ancestral, and that among them the female of *diana* is especially primitive.

It is a probable hypothesis that the recent evolution of *L. astyanax* provided this ancestral form with a model which it could approach by small and easy steps of variation. In this way it is possible to explain the appearance of the only character which, in Dr. Dixey's opinion, "is really peculiar to *A. diana* among its relatives . . . [viz.] the large expanse of blue ground colour . . ." which Dr. Dixey admits to be "like the corresponding feature in *B. astyanax* and *L. philenor*" (l. c., p. 106, footnote).

LIMENITIS (ADELPHA) CALIFORNICA, THE NYMPHALINE MODEL OF LIMENITIS LORQUINI.

The dominant genus *Adelpha* is the close ally and tropical American representative of the Holarctic and Oriental *Limenitis* (s. l.). *Chlorippe*, as employed by Godman and Salvin, is similarly the Neotropical representative and near ally of *Apatura*. The females of certain Palearctic *Apaturas* such as our own *A. iris*, L., are probably rough mimics upon the upper surface of the black white-marked species of *Limenitis*, such as *L. sibylla*, L. I have found in the Sierra Guadarrama, Spain, *Apatura iris*, L., flying with *L. camilla*, Wien. Verz., and closely resembling it upon the wing. The males of these species with their beautiful

blue iridescence are far less perfect mimics. Similarly in the Neotropical Region many species of *Chlorippe* have brilliantly iridescent blue males, while the females are beautifully mimetic of *Adelphas*. In other species both sexes are mimetic of the same genus. These *Chlorippes* differ from the *Apaturas* in the much greater brilliancy of the males and the far closer mimicry in the females. Nor are they altogether restricted to the *Adelpha* models; for the female of *C. zunilda*, Godt., is a mimic of such a *Callicore* as *candrena*, Godt. As in *Apatura*, the mimetic resemblance of *Chlorippe* is confined to the upper surface.

The powerful genus *Adelpha*, with over 70 species, of which 31 extend into Central America, forms a homogeneous tropical group, at once distinguished by the hairiness of the eyes in front from the allied *Limenitis* of the northern belt. A single species with smooth eyes, provisionally included in the genus by Godman and Salvin, is not only removed from the other *Adelphas* by this feature, but also by its distribution; for its northern form, *A. californica*, Butl., ranges through California into Oregon, while the southern form, *bredowi*, Hübn., extending from Guatemala through Mexico into Arizona, reaches much further north than any other species of the genus. In the brief statements printed in the Proceedings of this Society (1907, pp. lxxvii, lxxix, lxxx) I have followed Godman and Salvin in provisionally retaining this remarkable form in the genus *Adelpha*, a position also assigned to it by Dr. W. J. Holland ("Butterfly Book," p. 187). Since these brief notes were prepared, Mr. G. A. K. Marshall has also studied its position, and I agree with him that *bredowi* and *californica* should be removed from the southern genus *Adelpha* and provisionally placed in the heterogeneous northern group, *Limenitis*, a position assigned to them by Scudder in 1875 (Bull. Buffalo Soc. N. Sc., Feb. 1875, p. 233). The hairy eyes appear to be the only consistent point of discrimination between *Adelpha* and the northern *Limenitis*, and even this distinction breaks down in the hairy-eyed Indian species of the latter group. The smooth eyes and the northern range support the removal of *bredowi* from *Adelpha*, while its very different male secondary organs are not alone sufficient ground for generic separation from *Limenitis* (*Najas*) *lorquini*. The evolutionary point of view also supports the removal of *bredowi* and *californica* from *Adelpha*. Omitting these

two outlying forms, the whole genus is evidently the outcome of prolonged isolation and specific differentiation in the Neotropical Region ; while there are no reasons, except those founded on superficial resemblances of colour and pattern for supposing that *californica* and *bredowi* are the outcome of any such history. But in removing these two forms from *Adelpha* and transferring them to *Limenitis*, they lose a place in a definite and probably permanent genus and enter a heterogeneous and obviously provisional assemblage. Already the majority of the North American species have been split off as *Basilarchia*, while *lorquini*,* Boisd., has been included, with the European *populi*, in *Najas*, and the Chinese *albomaculata* separated as *Hypolimnesthes*. All these changes fall far short of what is required, viz. a careful revision of the whole assemblage of species included under the old *Limenitis*. Until this task is undertaken the creation of new isolated genera or subgenera may obscure rather than reveal the true relationships, and I therefore prefer to follow Godman and Salvin in provisionally placing the whole of the species under *Limenitis* in the broad sense, at the same time directing attention with these authorities to the composite nature of the group and the necessity for its thorough revision. I only differ from them by acting upon the doubt which they express, and removing a discordant element from *Adelpha*.

The southern form, *Limenitis bredowi*, Hübn., occurs in Guatemala, Mexico and Arizona, the northern form, *L. californica*, Butl., in California and Oregon. An example from each of these localities is figured on Plate XXV. *Californica* is also recorded by Dr. W. J. Holland (l. c., p. 188) from Nevada, and it would be extremely interesting to ascertain whether, on the S.E. borders of this State and of California, it interbreeds with and is transitional into *bredowi*, in Arizona. Dr. Holland says of the northern form—"In its habits and manner of flight it closely resembles the species of the genus *Basilarchia*" (l. c., pp. 187-8). And of the larval stage the same authority writes (p. 187) :—"while in general resembling the caterpillars of the genus *Basilarchia*, the segments are adorned

* *Lorquini* was included, with the other N. American species, in *Basilarchia*, in Proc. Ent. Soc. Lond., 1907, pp. lxxvii, lxxix and lxxx, following the arrangement of Dr. W. J. Holland. By a printer's error which unfortunately escaped notice, "W" (for West) has been printed instead of N (for North) on p. lxxx.

with more branching spines and with short fleshy tubercles giving rise to small clusters of hairs."

THE SOUTHERN LIMENITIS (ADELPHA) BREDOWI A MIMIC OF THE NEOTROPICAL ADELPHAS.—Mr. Marshall has kindly compared the patterns of the extremely fine series of *Adelphas* in the British Museum with that of *L. bredowi*, and he finds that the latter most closely resembles, on both surfaces, *A. dyonysa*, Hew., while, as regards the upper side alone, *massilia*, Feld., *lerna*, Hew., and *fessonia*, Hew., would come into the same assemblage. The yellowish tint of the band of *bredowi*, so clearly mimicked by *lorquini*, is apparently not itself a result of mimetic resemblance to the *Adelphas*; for all the Central American species have the band pure white or bluish-white, with the exception of *A. pione*, Godm. and Salv., and one or two species like it—all very dissimilar from *bredowi*.

THE GEOGRAPHICAL DISTRIBUTION OF THE WESTERN SPECIES OF LIMENITIS IN N. AMERICA.

L. californica occurs, as has been already mentioned, in Oregon, California and Nevada, and the southern *L. bredowi* in Arizona, Mexico and Guatemala; *L. lorquini* occurs with *californica* in the three first-named States, but extends much further north along the Pacific coast into British Columbia and Vancouver's Island. *L. weidemeyeri*, Edw., is described as ranging from the Pacific slope eastward to Montana, Nebraska and New Mexico. The 18 specimens in the British Museum are from Colorado and Utah. Scudder gives the distribution as the Rocky Mountain Region from Montana to Colorado (Bull. Buffalo Soc. N. Sc., Feb. 1875, p. 233) and concludes from the dates of specimens captured on the Yellowstone Expedition in 1873 that its periods resemble those of *B. arthemis* (Proc. Bost. N. H. Soc., vol. xvii, 1874-5, Ent. notes, IV).

The early stages of *weidemeyeri*, according to Edwards, resemble those of *L. archippus* (Can. Ent., xxiv, p. 107). The larvæ of *lorquini* are described by Dr. G. Harrison Dyar (l. c., xxiii, p. 172).

RELATION BETWEEN THE PATTERN OF *L. LORQUINI* AND THAT OF THE NON-MIMETIC *L. WEIDEMEYERI*.

In the above title I have not committed myself to the view that the pattern of *lorquini* has been evolved from

that of *weidemeyeri* in the manner that *archippus* and *astyanax* have sprung from *arthemis*. It is by no means improbable that, apart from the modifications which have produced a superficial resemblance to *californica*, the pattern of *lorquini* is more ancestral than that of the non-mimetic *weidemeyeri*.

On the upper surface the pattern of *lorquini* closely corresponds with that of *weidemeyeri*, but differs in the details described in the following section.

The apical area of the fore-wing is bright fulvous: the pale markings are cream-coloured instead of white: the whole discal band is placed nearer to the base of the wings, especially in the case of the hind: this band is also drawn out to a more pointed extremity towards the anal angle of the hind-wing: the constituent spots of the band, especially in the fore-wing, are more completely separated by strongly blackened veins.

An interesting feature possessed by certain individuals of both species is seen in the series of deep reddish spots, inconspicuous against the dark ground colour, placed along the outer border of the pale band in the hind-wing. These spots evidently represent the more prominent series commonly developed in *arthemis*. The complete series is occasionally quite distinct in *lorquini*; but as a rule the only conspicuous member is the spot at the anal angle of the hind-wing, where also a single spot of an outer series is often present. Of *weidemeyeri* I have had little material for careful study; but the red spots are faintly visible in one out of two specimens.

The inner edge of the white band of the fore-wing of *weidemeyeri* cuts the inner margin about opposite the centre of the white costal spot of the hind-wing, a spot much produced inwards towards the base of the wing as compared with the rest of the hind-wing series, as may be seen in Plate XXV, fig. 10 (in Fig. 1 the inward extension of the spot is concealed, especially on the left side, by the overlap of the fore-wing). In *lorquini*, which preserves the same general arrangement, the inner edge of the fore-wing band meets the costal spot of the hind-wing near its outer edge, thus forming a more pronounced step-like break than in *weidemeyeri*. The females of *lorquini* which I have had the opportunity of studying are in this respect in the condition of *weidemeyeri*. The white spot, which is almost invariably well developed in the fore-wing

cell of *lorquini*, is generally minute or altogether wanting in *weidemeyeri*. It is developed in the British Museum series of the latter species as follows:—Large on the upper surface in 1 male, of medium size in 1, minute in 7, and absent in 5: of medium size in 2 females, very minute in 1, absent in 3.

Nearly the whole of the above points of distinction between the upper surface patterns of *weidemeyeri* and *lorquini* can be verified by the comparison of Figs. 1 and 10 with 6, 7, and 8, on Plate XXV. The example of *weidemeyeri* represented in Fig. 1 possesses an unusually well-developed spot in the fore-wing cell, while Fig. 10 represents an individual in which it is minute, especially so upon the left side. The relatively high development of this spot in *lorquini* is almost certainly ancestral, as is the subapical series of white spots in the fore-wing (less developed than in *weidemeyeri*); for both interfere with the mimetic resemblance to *californica* (compare Figs. 2 and 3 on the same Plate). The submarginal white spots, especially developed in the apical section of the fore-wing hind margin of *weidemeyeri*, have almost disappeared in *lorquini*. Faint traces can however generally be detected, as in Figs. 6, 7 and 8.

The difference in tint between the white band of *weidemeyeri* and the cream band of *lorquini*, *californica* and *bredowi* could not be shown by photography without detriment to other parts of the negative. Mr. A. Robinson, of the Oxford University Museum, got over the difficulty by colouring the parts which should have been cream with a wash of very dilute aniline colour in water. Plate XXV has been prepared from a print thus treated.

The under surface of *lorquini* differs from *weidemeyeri* in the strong development of a dark rich mahogany-brown, replacing more or less completely the bluish-grey tint of the basal half of the hind-wing and of the submarginal markings. So far as my experience goes this replacement is on the average carried much further in the examples of *lorquini* from Vancouver's Island.

In those individuals of *lorquini* in which the suppression of these pale markings is least pronounced, the inner row of submarginal lunules—bluish-grey in the hind-wing, white in the fore—is larger and more conspicuous than in *weidemeyeri*.

MIMETIC RESEMBLANCE STRONGER IN THE SOUTHERN
EXAMPLES OF *LORQUINI* WHICH ARE GEOGRAPHICALLY
COINCIDENT WITH CALIFORNICA.

The following features, described in the preceding section, promote a superficial resemblance of *lorquini* to *californica* :—

- (1) The fulvous apical area of the fore-wing.
- (2) The cream tint of the discal band crossing both wings.
- (3) The fulvous marking at the anal angle of the hind-wing.

Of these features the last is so excessively variable and so often absent in both northern and southern examples, that very long series would be required in order to compare the average development in the two areas. This element in the mimetic resemblance is apparently in-cipient and imperfectly established.

The discal band is apparently paler in the northern *lorquini* than the southern. The difference, which is excessively slight, may be best seen when a series of individuals are compared; but I do not think that the conclusion can be regarded as safely established until a large number of fresh specimens have been carefully examined from this point of view.

As regards the most important feature in the mimetic resemblance—the fulvous apical area—there is undoubtedly a much greater average development in the examples of *lorquini* from California and Oregon (Figs. 7 and 8 respectively) than in those from British Columbia and Vancouver's Island (Fig. 6), entirely beyond the range of the model.

In many of the southern specimens of *lorquini* the fulvous apical patch extends inwards (as in Fig. 8 on Plate XXV) nearly as far as the outer border of the costal end of the discal band in the fore-wing. The colour is of a richer deeper shade than the bright tawny patch of *californica*.

On the under surface the development of the inner row of submarginal bluish-grey lunules into a festooned band in a large proportion of the examples of *lorquini* is probably caused by mimetic approach to *californica*. At any rate the marking is often a more conspicuous feature

in *lorquini* than in *weidemeyeri*. The study of its relative development in the southern part of the range would require a much larger number of specimens than I have as yet had the opportunity of seeing. There is however no doubt that the feature is generally suppressed in Vancouver's Island and that it is usually well developed in British Columbia.

The undoubted affinity between *californica* and *lorquini* may lead naturalists to conclude that their resemblance is due to relationship and not to mimetic approach. It is commonly forgotten that mimicry, being *independent* of affinity, occurs between forms of all degrees of relationship, the closest as well as the most remote. When the chief mimetic element in the pattern of *lorquini* is examined it is at once apparent that the likeness is superficial, and that the appearance is produced in a manner entirely different from that of the model. The orange patch on the fore-wing of *californica* is a clearly defined sub-apical and submarginal marking, roughly resembled in the mimic, *lorquini*, by the inward growth of a brown marginal marking (compare Figs. 2 and 3 with 6, 7 and 8 on Plate XXV). There can be little doubt also that the cream tint of *lorquini* is not ancestral, but due to recent modification of white markings like those of *weidemeyeri*, *arthemis* and many Palearctic species of *Limenitis*. The average increase of mimetic likeness in the area occupied by the model confirms in the most convincing manner the conclusion that the resemblance is due to mimicry and not to affinity.

DIFFERENCES BETWEEN CALIFORNICA AND BREDOWI ARE
SUCH AS TO PROMOTE A RESEMBLANCE BETWEEN THE
NORTHERN FORM AND LORQUINI.

a. *The shape of the wings*.—The marked difference in the shape of the wings between the males of the northern *californica* and the southern *bredowi* is well seen by comparing Figs. 2 and 3 with 4, 5, and 9 on Plate XXV. This distinction, apparently, does not hold in the other sex; for the few southern females I have seen exhibited the proportions of the northern form. The difference was clearly explained, although without reference to the females, by A. G. Butler in his original description of *californica* (Proc. Zool. Soc. Lond., 1865, p. 486):—"the wings

are much more rounded than those of *H. Bredowii*, and are not produced at the end of the second median nervule." The more rounded shape of the hind-wings is also very clear in the northern form, those of the southern (Figs. 4, 5 and 9) being more triangular in shape, and the hind margin tending to form a straight line with that of the fore-wing to a greater extent than in *californica* (Figs. 2 and 3). In all these points by which the shape of *californica* is rendered different from that of *bredowi*, there is resemblance between it and *lorquini*.

b. *The fulvous mark at the anal angle of the hind-wings.*—It is unnecessary to describe this distinction in any detail; for the characteristic form of the marking is well shown in Figs. 4, 5 and 9, together with its diminution in the northern form (Figs. 2 and 3). It is barely seen in Fig. 3, although visible in the specimen itself. Fig. 2 however shows the marking distinctly and affords a fair comparison with the condition represented in the southern examples (Figs. 4, 5 and 9). Here too the divergence from the southern *bredowi* is coincident with resemblance between the northern form and *lorquini*.

c. *The step-like break in the band at the junction of fore- and hind-wings.*—As regards this feature *californica* is certainly far nearer than the southern *bredowi* to the appearance presented by *lorquini*. *Bredowi* approaches the condition, seen in many *Adelphas*, of a straight continuous band sweeping from fore-wing on to hind. Compare the representation of the southern form in Figs. 5 and 9, with those of the northern in Figs. 2 and 3, and the latter with *lorquini*, shown in Figs. 6, 7 and 8. The break on the inner margin of the band in the Arizona example represented in Fig. 4 is intermediate between the more northern *californica* and more southern *bredowi*. The difference between the right and left sides of Fig. 9 was probably caused by the "setting." The step-like break of *californica* is produced by the small size of the last pale spot on the inner margin of the fore-wing, as well as by the direction of the last spot but one, which is so placed that its inner border forms a considerable angle with that of the hind-wing band. If Figs. 4, 5 and 9 be compared in this respect with 2 and 3 it will be seen that the last spot of the southern form is much larger,* while

* This point of distinction between *californica* and *bredowi* was described by A. G. Butler in Proc. Zool. Soc. Lond., 1865, p. 465.

the last spot but one is twisted into a much closer coincidence with the inner border of the hind-wing band. As regards the position of the last spot but one, *lorquini* goes much further than *californica*, the direction of the inner border of the fore-wing spot coinciding with the outer border of the hind-wing band (Figs. 6-8).

Apart from the orientation of the last spot but one in the band of the fore-wing, the very characteristic hour-glass-like form seen in greater or less perfection in all the figures on Plate XXV is probably an ancestral feature. There appears to be no doubt that the indentation of the inner side of the spot tends to be obliterated and replaced by a straight contour in *bredowi* (compare Figs. 2 and 3 with 4, 5 and 9). In this respect the northern form is probably ancestral. At any rate an approach to *lorquini* in this feature is unlikely; for in *lorquini* itself the inner contour is less indented than in *californica*.

The fact that the break in *californica* approaches but does not equal that of *lorquini*, attaining in fact about the condition of *weidemeyeri* (see Figs. 1 and 10), supports the conclusion that in this respect *lorquini* acts as a model and *californica* as a mimic.

The step-like break, together with the more outward position of the spot below the end of the cell in *californica*, tends to give the band of the fore-wing an irregular zigzag W-like appearance, suggesting the form which is more fully and symmetrically attained in *lorquini*. The example of *bredowi*, represented in Fig. 9, is in the opposite condition, with a comparatively straight fore-wing band, while the specimens seen in Figs 4 and 5 are intermediate. The outward displacement of the spot below the cell of *californica* promotes this superficial resemblance to *lorquini*, in spite of the fact that the corresponding spot of the latter occupies a more inward position. It produces this effect by increasing the angulation of the irregular zigzag formed by the fore-wing band.

d. *The external border of the hind-wing band.*—The fifth spot (from the costa) of the hind-wing band of *californica* projects beyond the rest of the outer border to a greater extent than in *bredowi*, and thus disturbs the regular straight or slightly concave sweep which is so characteristic in the southern form. Although resembling no particular feature of *lorquini*, the difference probably promotes a general superficial resemblance to the distinctly convex

contour of the more interrupted hind-wing band of this species.

SLIGHTLY INCREASED RESEMBLANCE TO THE *ADELPHA*
PATTERN IN THE MOST SOUTHERN EXAMPLES OF
BREDOWI.

In one respect the upper surface of the most southern specimens of *bredowi*, from Guatemala, appears to show the influence of *Adelpha* more strongly than the more northern examples from Mexico and Arizona. In both the southern examples I have had the opportunity of studying there is a small fourth spot in the fore-wing band (counting from the costa), absent from the numerous more northern specimens of *bredowi* and *californica* which I have seen. This small spot is clearly shown, especially on the right side, in Plate XXV, fig. 5. It is considerably larger in a second Guatemalan specimen in the Hope Department. This feature tends to make the fore-wing band more continuous than in the specimens from further north. This spot is however generally represented on the under surface of *bredowi* from more northern parts of its range, and is often seen in the same position in *californica*.

HAS RECIPROCAL (DIAPOSEMATIC) MIMICRY BEEN ESTABLISHED BETWEEN *CALIFORNICA* AND *LORQUINI*?

There is only one apparent means of escape from the conclusion that we are confronted with a striking example of Diaposematic resemblance between those two species. It may be held that *californica* possesses an ancestral pattern from which *bredowi* in the south has been modified by mimicry of the prevalent *Adelphas*. In certain respects this interpretation is probably correct. Thus the form of the wings in the female of the southern subspecies supports the conclusion that their similar form in both sexes of the northern subspecies is ancestral. But it would, I think, be a curious coincidence if all the details by which the northern *californica* differs from *bredowi* and superficially resembles another species, should be ancestral survivals unconnected with the presence of that other species—*lorquini*.

Are we to regard the evident *Adelpha*-like elements in the pattern of *californica*—only less strongly marked than those of *bredowi*—as ancestral or as the result of mimetic influence spreading with diminishing effect beyond the

range of the models? The latter seems to be a far more probable hypothesis; for we have a good parallel example in *lorquini* itself, where the mimetic influence has been shown to lessen as the mimic passes northwards out of the range of its model. At the same time it must be remembered that species of *Limenitis* (s.l.) with an *Adelpha*-like pattern exist in the Oriental Region; and it is a possible hypothesis that these species and *californica* represent the ancestor of the Neotropical *Adelphas*. The cream-colour of the band of *californica* is at any rate an ancestral feature, unconnected with mimicry of the *Adelphas*.

We may hope with some confidence that this fascinating but difficult problem may receive a final solution when the structural relationships of all the species of *Limenitis* and *Adelpha* in their broadest sense shall have been made out in detail. In the meantime, as I have said above, the origin of nearly the whole upper surface pattern of *californica* as the result of the spreading northward of an influence exerted by the genus *Adelpha* in the south, appears to be the safest provisional conclusion to adopt. The following facts seem to support it and at the same time to suggest that reciprocal mimicry of *lorquini* has also taken place.

The number of species of *Limenitis* in N. America points to an ancient existence in this portion of the Holarctic Belt. At the same time their mimetic relationships in the eastern section of the Continent have been shown to be extremely recent. The change in *lorquini* as it passes north of the range of its model (*californica*), suggests that its mimicry is also extremely recent. That the North American *Limenitis* are highly susceptible to mimetic influence is shown in the fact that they contribute such a high proportion of the butterfly mimics of the Continent, and that they furthermore produce the most divergent mimetic patterns. In the eastern section of the Continent this recent development of mimicry has been shown to correspond to a recent invasion of *Danaine* models and to the influence of *Papilios*—themselves mimics of recent date—exhibiting most beautiful examples of transition in the stages of developing mimicry. It is therefore extremely probable that the very recent mimetic pattern of *lorquini*—far more imperfect than that of any other mimicking *Limenitis* in America—also corresponds to the

recent appearance of an *Adelpha*-like model in a portion of its range. It is extremely difficult to believe that so imperfect a result would have been produced in a member of such a sensitive group if contact with the model had been prolonged.

Finally there is the fact that, as shown by Godman and Salvin, the southern form *bredowi* extends into Arizona much beyond the range of any true *Adelpha*, while examples from the most southern part of its range in Guatemala only exhibit, in the minute detail described on p. 485, an increased likeness to the *Adelphas*. The mimetic resemblance of *bredowi* is an established and stable product, but slightly increased by deepest penetration into the area of the models, maintained well beyond their northward limit, and only modified when the range of *lorquini* is entered in California.

The relationship of this interesting species to its *Adelpha* models indicates a marked susceptibility to influences of the kind, and supports the conclusion that the northern form has been reciprocally modified by the presence of its abundant mimic, *lorquini*.

CONCLUSIONS.

A. THE EASTERN SECTION OF NORTH AMERICA.

1. The Old World ancestor of the Danaine butterfly, *Anosia plexippus*, invaded the New World by way of the north, at a time sufficiently remote to permit of the acquisition of generic distinction.

2. The invader was mimicked by an indigenous species of *Limenitis*, closely similar to and probably identical with *L. arthemis*, which thus originated *L. archippus*.

3. A second closely allied Old World Danaine invaded the New World as *Danaida berenice*. This later invasion is so recent that the generic characters remain unchanged.

4. In Florida, the second Danaine intruder has modified the mimic of the earlier intruder into a superficial likeness to itself, thus producing the *floridensis* form of *L. archippus*.

5. The specially protected *Papilio* (*Pharmacophagus*) *philenor* is mimicked by three species of *Papilio*, the different stages to which the resemblance is carried indicating recent modification.

6. The three mimicking species of *Papilio*—*troilus*, *asterius* (female), and *glaucus* (female f.)—exhibit secondary mimicry of one another.

7. Secondary mimicry of these three *Papilios* has led to the evolution of *Limenitis astyanax* from *L. arthemis* at so recent a date that the two forms occasionally interbreed where they meet.

8. The female of *Argynnis diana* has been modified into a tertiary mimic of *L. astyanax*.

B. THE WESTERN SECTION OF NORTH AMERICA.

9. An ancestral northern Nymphaline butterfly belonging to the heterogeneous group "*Limenitis*" penetrated the area of the dominant Neotropical genus *Adelpha* and gained a superficial resemblance to its much-mimicked pattern.

10. The influence of *Adelpha* spread far beyond the range of the models into the northern subspecies *californica*, which in turn influenced, and has probably itself been reciprocally influenced by, *L. lorquini*, in California and Oregon.

11. The influence of *californica* upon *lorquini* spreads northward, with diminishing effect, beyond the range of the model, into British Columbia and Vancouver's Island.

12. Some of the ancestral features of *lorquini* are preserved in the non-mimetic species *weidemeyeri*.

NOTE.—A further study of the larvæ of *Danainæ* tends to throw doubt upon the validity of *Anosia* as a distinct genus. Two pairs of filaments are borne by the larva of *plexippus* and of *genutia*, probably its nearest ally in the Old World: three pairs are similarly characteristic of *bernice* and its probable representative, *chrysippus*.

Dr. Jordan, who has examined the male genitalia, kindly informs me that *chrysippus* and *bernice* are of the same type, while *genutia* and *plexippus* are of a second type. He agrees that *plexippus* cannot be generically separated from the other brown *Danainæ*s. E. B. Poulton, Dec. 16, 1908.

EXPLANATION OF PLATE XXV.

[See *Explanation* facing the PLATE.]

EXPLANATION OF PLATE XXV.

Examples of *Limenitis (Najas) lorquini* and of *Limenitis (Adelpha) californica* (N.) and *bredowi* (S.), from various localities in their north-and-south ranges. The figures show the resemblances which are evident at the overlap, but diminish in *lorquini* to the N. and in *bredowi* to the S.

All the specimens figured are males. The originals of Figs. 2-9 are in the Godman-Salvin Collection in the British Museum of Natural History; of Figs. 1 and 10 in that part of the Godman-Salvin Collection which has been incorporated in the British Museum Collection.

All the figures are about $\frac{3}{4}$ of the natural size.

1. *Limenitis (Basilarchia) weidemeyeri*, Edwards. Glenwood, Colorado (6000 ft.), July 6, 1893. H. J. Elwes.

2. *Limenitis (Adelpha) bredowi*, Hübn., subspecies *californica*, Butl. Sissons, Oregon, May [1888]. F. D. Godman. The specimen bears only the month, but Dr Godman, F.R.S., kindly informs me that the year was 1888.

3. *Limenitis (Adelpha) bredowi*, subspecies *californica*. Yosemite, California, May 1888. F. D. Godman.

4. *Limenitis bredowi*, Hübn. Fort Grant, Arizona. Morrison.

5. *Limenitis bredowi*. Santa Rosa, Vera Paz, Guatemala. G. C. Champion.

6. *Limenitis (Najas) lorquini*, Boisd. Esquimalt, Vancouver's Island. Markham.

7. *Limenitis lorquini*. Sissons, Oregon, May [1888]. F. D. Godman. See description of Fig. 2.

8. *Limenitis lorquini*. Yosemite, California, May 1888. F. D. Godman.

9. *Limenitis bredowi*. Xucumanatlan, Guerrero, Mexico (7000 ft.), July. H. H. Smith.

10. *Limenitis weidemeyeri*. S.W. Colorado, Morrison.



Colorado.

1
weidemeyeri, 1 ♂.



Oregon.

2



Vancouver I.

6



Oregon.

7



California.

8



California.

3

californica, 2 ♂.



lorquini, 3 ♂.

Mexico.

9



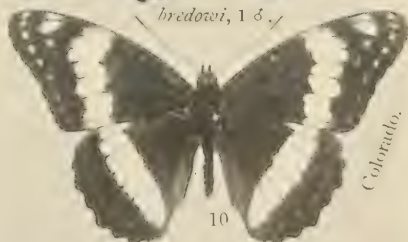
Arizona.

4

Guatemala.

5

bredowi, 2 ♂.



bredowi, 1 ♂.

Colorado.

10

weidemeyeri, 1 ♂.

Alfred Robinson, phot.

All figures are about $\frac{2}{3}$ of the natural size.

Witherby & Co.

Resemblances between *Limenitis lorquini*, and *L. californica* at their geographical overlap, diminishing in *lorquini* to the N., and the *bredowi* form of *californica* to the S.

- XXII. *Some bionomic notes on British East African butterflies*, by the REV. K. ST. AUBYN ROGERS, M.A., F.E.S., of Wadham College, Oxford; *with further notes and descriptions* by PROFESSOR E. B. POULTON, D.Sc., M.A., F.R.S., etc.; *and an Appendix containing the description of new British East African forms*, by ROLAND TRIMEN, M.A., F.R.S., etc.

[Read December 4th, 1907.]

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APPENDIX :

Description of new forms of British East African
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INTRODUCTION.

[I HAVE added to the following memoir many records of observations received in letters from the author. In most cases such notes are printed separately with the address and date of the letter in which each was contained. Occasionally the record had been cut out of the original letter and the address lost. In a few cases the statements in letters have been added to the memoir without any indication. My own notes, etc., are always clearly discriminated, and signed by my initials.

E. B. POULTON.]

These notes on the Bionomics of East African butterflies owe not merely their origin but their whole scope and character to Professor Poulton. The observations on which they are based were undertaken at his suggestion and under his guidance, and he has been good enough to work out the whole collection and to look over all the sheets of the paper, and send me the most valuable help and suggestions during its progress. In particular the tables of dates and localities of the several combinations are due entirely to him, and it is not too much to say that without his aid these notes could never have been compiled at all.

I have also to acknowledge the kind assistance of Dr. Dixey with regard to the *Pierinæ*. He has continually placed at my disposal his unique knowledge of this group,

and has given me every help in tracing out the relationships of the whole series.

I propose in the first place to convey some idea of the character and seasons of the various localities. These are—

- (1) Mombasa and the Coast hills.
- (2) Taveta and Kilimanjaro.
- (3) Kikuyu.

(1) *Mombasa and the Coast hills.*

The climate of this area is typically tropical: the elevation hardly reaches 1000 ft., except in the case of single hills such as Mangea, which is 1600 ft. The air is moist and the temperature high throughout the whole year.

There are two wet seasons, lasting roughly during April–June and November–December, in the year, and the driest season is January–March, at which period the temperature is highest. It is rather singular that a family of *Belenois severina*, Cram., which was bred at Mombasa during this season belonged entirely to the wet season phase. In fact the seasonal forms of *Pierinæ* are most puzzling and unaccountable. For instance, all the specimens of *Pinacopteryx liliana*, Gr.-Sm., which I took at Taveta during the long dry season, belonged to the wet phase, whilst I took a good series of the dry phase at Mombasa at the beginning of July before the rains were over, in an exceptionally wet year.

This coast region is for the most part open cultivated country with extensive patches of woodland and some low forest. It is generally well watered at the southern end, of which Rabai is the centre. Further north it is much drier and becomes greatly parched at the end of the hot dry season; but I have not been able to do much collecting in this district. All along the coast the hills rise rapidly, leaving a narrow strip of littoral about 10 miles wide in most places. These hills do not reach a greater elevation than 1200 ft., except Mangea, which is 1600 ft. The greater part of my collecting has been done in these coast hills where the large black-and-white *Amauris*-centred combination is highly characteristic, and the important association centring round the larger red black-marked *Acraeas* is also very much in evidence.

(2) Taveta and Kilimanjaro.

Although these are placed together as contiguous areas they differ entirely in climate.

Taveta has a comparatively small rainfall, averaging perhaps 30 inches, of which the larger portion falls between mid-March and mid-May. The rest of the year is an almost continuous dry season, broken only by a few heavy showers in November. The day temperature is high, rising well over 90° in the hot season, and the night temperature much lower, often falling below 70° even during the hottest period of the year, whilst in the cool season it sometimes sinks to 55° . The elevation is 2500 ft.

The whole country is arid with the exception of the forest, which is well watered by springs, and occupies an area of some 10 square miles. The timber differs greatly from the lower growth near the coast; for the trees are of great size, and where they have not been cut the forest is very dense.

Kilimanjaro, on the other hand, has a large rainfall which extends over the whole year with the exception of two or three months from mid-December to mid-March. Cultivation extends up to about 6000 ft., above which there is a dense low forest as far as 8000 or 9000 ft.* In some places there are outlying patches of forest at much lower elevations, but generally speaking the country is open and well cultivated, supporting a large population. Most of my collecting was done at about 5000 ft., and I believe my native collectors worked at much the same elevation.

(3) Kikuyu.

The Kikuyu country, at a height of from 5000 to 8000 ft. and even higher, is also well cultivated ground. It rises from an elevated plateau and is very hilly, especially in its northern part.

I did a little collecting at Nairobi, the head-quarters of the Colonial Government, and from there went to Kijabe,

* In the sentence "I did go as far as the forest which extends upwards for about 6000 ft.," quoted from my letter by Professor Poulton in Proc. Ent. Soc. Lond., 1906, p. lix, the word "for" should be replaced by "from."

which is on the eastern slopes of the Rift Valley and a fine forest country.

Most of my collecting, however, was done in Northern Kikuyu at a place called Weithaga (6000 ft.), about 15 miles due west of Fort Hall, and perhaps 60 miles north of Nairobi.

The country consists of a series of long ridges with very steep narrow valleys between them, running down to the plain from Mount Kinangop. Most of these valleys are swampy, but they are often well cultivated, as indeed is the whole country, the population being very large and entirely dependent on agriculture. Woods are few and the whole country is very open.

I also did a little collecting at Mogoiri (6500 ft. to 8000 ft.), which is a large district to the west, at a somewhat higher elevation, rising in its western part towards the slopes of Kinangop: also at Tusu (8000 ft.), lying still further west and even higher up on Kinangop. This last locality is, in part, low forest.

The rainfall throughout this whole area is fairly high, for such a cool country, amounting to some 50 inches, and the land is never really dried up. Green grass is plentiful even during the hot dry season, so that seasonal forms are not well pronounced. I succeeded in breeding a species of *Precis*, *P. archesia*, Cram., but all my specimens were but little removed from the full wet season phase. Both forms of *Precis sesamus*, Trim., are, on the other hand, well marked and abundant.

The material illustrating all parts of this paper exists in the Hope Department of the Oxford University Museum, where the authorities will always be glad to make it available for the study of Naturalists interested in the subject of insect bionomics.

A. DANAINE-CENTRED MIMETIC COMBINATIONS.

Although, so far as I am aware, the mimetic *Papilio rex*, Oberth., has not as yet been taken in the Taveta and Taita districts, it is of interest to observe that the model, *Tirumala (Melinda) formosa*, Godm., certainly occurs there. I have had one specimen brought to me at Taveta, and on the journey from Voi to Taveta in 1905 I saw several

on Dabida Hill, although I was unable to capture any of them.

I. *Black-and-white Eastern Amauris-centred Combinations from the Coast District of British East Africa.*

This striking series of conspicuous butterflies contains two well-marked combinations, respectively grouped around *Amauris niavius*, L., sub-sp. *dominicanus*, Trim., and round *A. ochlea*, Boisd. It also includes a number of outlying mimetic forms which have evidently been influenced by the dominant species of black and white *Amauris*, but do not resemble the pattern of any particular model.

Although the two combinations are well marked, there is a species, *Euranthe wakefieldi*, Ward, ♀, which possesses a pattern of the *ochlea* type and yet upon the wing more closely resembles the *dominicanus* association. It is probable that the outlying species also serve to hold both combinations together and to weld them into a single complex association of black white-marked species. For this reason, the time relationships of the whole of the members of both combinations at Rabai are recorded in a single table, which shows that many of the species fly together. This diary of captures extends over the eleven months from the beginning of March 1906 to the end of January 1907.

It must be remembered that, with the exception of the specimens taken on May 12 and on September 15, no special attempt was made to capture as complete a series as possible on a single day. Furthermore, the abundant models were avoided, while rarer species, such as the *Euxanthes*, were especially sought. Hence the following diary gives a wrong idea of the proportionate abundance of the constituent species.

Allowing for this, the solid fact of the occurrence of the various members of the two combinations in the same place and at the same time is proved over and over again in the following table :—

*Tabular Statement of members of Black-and-White Amavis-centered Combinations captured at Rabai,
March 1906-Jan. 1907. W = worn: C = chipped: + = slightly.*

DATES OF CAPTURE.	DANAEÆ.			NYMPHALINÆ.			ACRÆINÆ.			PAPILIO-NINÆ.	
	<i>Amavis</i> <i>auratus</i> , sub-sp. domi- canus.	<i>Amavis</i> <i>ochlea</i> .	<i>Psilodactyla</i> <i>peritoria</i> f. <i>expansa</i> .	<i>Hypolimnas</i> (<i>Eurata</i>) <i>usambara</i> .	<i>Hypolimnas</i> (<i>Eurata</i>) <i>vahlbergi</i> .	<i>Hypolimnas</i> (<i>Eurata</i>) <i>discolor</i> .	<i>Hypolimnas</i> (<i>Eurata</i>) <i>kirbyi</i> .	<i>Eucanthe</i> <i>tiberius</i> .	<i>Acrona</i> <i>escriba</i> , <i>aganeæ</i> .	<i>Plat</i> <i>nom</i> <i>aganeæ</i> .	<i>Protopia</i> <i>daridius</i> (sub-sp.), f. <i>tibialis</i> , f. <i>hippo-</i> <i>cratus</i> .
1906.											
March 3.	1	...	...	...	...	...
March 31.	1	...	1♂ C-	...	...	...
April 7.
April 11.	1	...	...	1♂ C-	...	...	...
April 14.	1	...	...	3♂, 1 C-	...	...	1♀
April 28.	1	...	...	...	...	...	1♀
May 12.	1 W	1 W	1 W	1 W	1 W	...	...	...	...	...	...
May 23.	1	...	...	2♂ C-	...	...	1♀
May 26.
May 28.	1♂ W-	...	...	...	...	...
June 2.	1♀ W-	...	...	...	...	...
June 9.	1♂ C-	...	...	...	...	1♀
June 23.	1	...	...	1♂	...	...	1♀
June 26.
July 7.	1	...	...	1♂ C-	...	...	...
July 28.	1	...	...	...	...	...	...
Sept. 16.	1♀ W- Pl. XXVI, fig. 1	1♀ C- Pl. XXVI, fig. 3	...	1 W, C.	...	1 W-	...	1♂ C-	...	...	...
Oct. 20.	1♂ C+	...	...	...
Oct. 27.
Nov. 3.
Dec. 22.
Dec. 29.	1 W, C, 1 Pl. XXVII, fig. 4	...	...	...	...	...	...	1♀ C-	...
1907.											
Jan. 5.
Jan. 19.	1♂ C-	...	...	...	...	...
Jan. 26.	♂♀ in cop. the ♂ W + C + ♀ Pl. XXVII, fig. 3	...	...	...
	1♂	...	...	1♀ W, C-	...	...	...

* One with ochreous markings, the other ochreous, becoming fulvous, especially in the largest markings.

a. *Amauris niavius dominicanus*-centred Combination.

This well-marked combination contains, in addition to the Danaine model, the following species, of which all except *Euxanthe wakefieldi*, Ward, ♀, are beautiful mimics. The pattern of this latter is indeed rather that of the *ochlea*-centred combination, with which it is represented on Plate XXVII, fig. 2. In the living state however, in spite of its pattern, the female of *Euxanthe wakefieldi* is more closely allied to the larger more broadly white-marked combination of *Amauris niavius dominicanus*, well shown on Plate XXVI.

NYMPHALINÆ. *Hypolimnias (Euralia) usambara*, Ward.
Hypolimnias (Euralia) wahlbergi, Wallgr.
Euxanthe wakefieldi, Ward, ♀.

PAPILIONINÆ. *Papilio dardanus*, Brown, sub-sp. *tibullus*,
 Kirb., ♀ f. *hippocoon*, F.

Amauris niavius, L., sub-sp. *dominicanus*, Trim.⁸ (Plate XXVI, fig. 1). The central model of this association is very common in shady places, and sometimes extremely abundant; whilst its broad black and white markings make it very conspicuous.

[Rabai, May 1, 1906. *A. dominicanus* can almost always be distinguished even on the wing from *H. wahlbergi* and *P. dardanus*. *Wahlbergi* is almost destitute of marginal white spots and so the black and white look much more distinct; whilst *P. dardanus* has this marginal series much more developed than the model.]

Euralia (Hypolimnias) usambara, Ward (Plate XXVI, fig. 3), is the largest member of the combination, and, in spite of considerable differences in details of coloration, strongly resembles *Euxanthe wakefieldi* ♀ on the wing, when the bright, orange-brown border on the under side of the hind-wings somewhat detracts from its apparent size. As far as my experience goes it is by far the rarest species of the combination and I have only met with it in one locality at Rabai.

[Rabai, September 12, 1908. I have taken two more specimens of *Euralia usambara* a week ago. I must confess that the first took me in completely. It was hovering over the end of a branch quite in the manner of the *Amauris* model, for which I mistook it, and was just considering whether I should catch it for my spiders, when it

settled and I saw what it was. Another appeared on the scene soon afterwards.]

Euralia (Hypolimnias) wahlbergi, Wallgr. (Plate XXVI, fig. 4), is common, and is, like the *Amauris*, a denizen of woods and forests, but its habits are somewhat different. It prefers the more open parts of the woods and generally sits on the upper side of leaves and thence pursues butterflies of its own and other species; but it not unfrequently may be seen resting with its wings hanging down in a position entirely similar to that of *dominicanus*, and such is probably its usual position of rest at night. It is quite possible that this attitude is of great importance in the struggle for existence, and I would offer the suggestion that the period of nocturnal rest may be far more dangerous to many species than the more active period of the day, when, to judge from the rarity of observed attacks by birds, most butterflies are quite able to take care of themselves. The period of rest, however, begins for butterflies at a time of the day when birds are most active in the pursuit of food, whereas the butterflies are quiescent and would, if discovered, fall an easy prey to their enemies. This principle has also been observed to be in operation in Siam by Mr. N. Annandale,* and in South Africa by Dr. G. B. Longstaff.†

Euxanthe wakefieldi, Ward, ♀ (Plate XXVII, fig. 2). The males of this species do not really come into the association at all, but the female is largely modified in the direction of the *Amauris* by the increased size of all the pale spots and areas, and also by their colour, which is much lighter and whiter in tint, so that on the wing the butterfly appears to be simply black and white. This resemblance is greatly increased by the shape of the wings as compared with those of its own male, which has the fore-wings exceedingly short and broad,—so much so as to give it a very distinctive appearance, especially in flight. On the other hand, the wings in the female are much produced so as to approximate in shape to those of the primary model. During flight this female bears an even closer resemblance to the Papilionine co-mimic, shown on Plate XXVI, fig. 2, than to the Danaine model (Fig. 1), especially in the prominently spotted dark border of the hind-wing. In habits *E. wakefieldi* resembles more closely

* Proc. Roy. Phys. Soc. Edinb., 1900, No. xxix, pp. 439-44.

† Trans. Ent. Soc. Lond., 1906, p. 118.

the species of *Euralia*, being generally seen sitting on the outer leaves of trees, and the males being very fond of pursuing each other with great activity. It is, however, frequently to be found at rest on tree-trunks, and I have observed the female settled with its wings pendent, and in this position bearing a very strong resemblance to the Danaine model. I have little doubt that this species is specially protected and a Müllerian mimic. The facts stated about the allied *E. tiberius* (p. 501) are equally true of *wakefieldi*.

[Taveta, July 5, 1905. They are very fond of chasing each other round and round and have a very graceful floating flight, which no doubt accounts for their becoming mimics of *A. dominicanus*, of which the flight is somewhat similar. The male generally settles on tree trunks, but I have seen the female more than once settle on a branch or twig with its wings hanging down exactly after the manner of *A. dominicanus*, to which it bears a strong resemblance on the wing.]

Papilio dardannus, Brown, sub-sp. *tibullus*, Kirby, female form *hippocoon*, F. (Plate XXVI, fig. 2). This is by far the commonest form of the female and is of very frequent occurrence. It is readily distinguished during flight by the prominent sub-marginal spots in the dark border of the hind-wing. I have met with this form in some abundance as far away as Nairobi in the Kikuyu country, and it remains the dominant variety of the female from this locality westward to the Atlantic coast.

1. The Relative Abundance of the members of the *Amauris niavius dominicanus*-centred Combination.

In my experience *Euralia usambara* is the only really rare member of the association, and the only one with a restricted range. All the other constituent species have a considerable range in the Coast district. The relative abundance of the different species varies considerably in different localities. At Taveta, for instance, the primary model, *A. niavius dominicanus*, outnumbered many times all the others; while at Rabai its dominance was by no means so well marked.

b. *Amauris ochlea*-centred Combination.

In addition to the Danaine model this combination contains the following species, of which all except *Euranthe*
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tiberius ♀ are fairly good mimics. This combination is however more distinguished than that last described by the strength and beauty of the secondary mimetic resemblances. The model and chief Nymphaline mimics are well seen, represented $\frac{2}{3}$ of the natural size, on Plate XXVII. The plate includes the female of *Euxanthe wakefieldi* (Fig. 2) with a pattern resembling that of this combination, but in life an outlying member of the association with *A. dominicanus* for its centre.

NYMPHALINÆ. *Pseudacræa lucretia*, Cram., sub-sp. *expansa*, Butl. (Plate XXVII, fig. 4).
Euralia deceptor, Trim. (Fig. 6).
Euralia kirbyi, Butl. (Fig. 5).
Euxanthe tiberius, Gr.-Sm., ♀ (Fig. 3).
Aterica galene, Brown (white f. of ♀).

Amauris ochlea, Boisd. (Plate XXVII, fig. 1). The habits of the central model of this association are quite like those of *A. niavius dominicanus*, except that it is a little more partial to the open country, and is fonder of flowers.

Pseudacræa lucretia, Cram., sub-sp. *expansa*, Butl. (Plate XXVII, fig. 4). This species often settles on leaves with wings expanded, and in every way it has much more the appearance of a large *Neptis* than any of the other members of the combination. Although the pattern of this species so closely resembles that of the two *Euralias* the *Pseudacræa* appears whiter on the wing and has a more floating flight. It is possible that the characteristic curve of the large spots of the fore-wing, to which Professor Poulton has drawn attention, has been influenced by the curved band in the fore-wing so well marked in this genus, of which *N. agatha* is a good example. I have only seen the species near Rabai.

Euralia deceptor, Trim. (Plate XXVII, fig. 6), and *E. kirbyi*, Butl. (Fig. 5). The two *Euralias* resemble one another strongly, especially on the wing, and are active insects very fond of pursuing butterflies of their own and other species. I have little doubt, however, that in the position of permanent rest they would follow the Danaïne model, and in fact I have observed *E. deceptor* in this attitude.

[Mombasa, April 5, 1905. I have only seen *Pseudacræa expansa* near Rabai, and *Hypolimnas* (*Euralia*) *deceptor* and

ivahlbergi I have only taken in the same district, i.e. on the Coast hills. *H. deceptor* is not uncommon, but it is very difficult to get in good condition.]

[Rabai, May 1, 1906. The first specimen of *H. deceptor* I ever captured was settled with its wings hanging down just like *ochlea*, but I have never observed this since and I have seen dozens of the species. It is very fond of settling on the outer leaves of small trees and chasing its companions from time to time, and on the wing is not at all unlike *H. misippus*.]

[*Euralia kirbyi* is included in the observations on *E. deceptor* recorded in the above extracts from two letters. The two species, which are extraordinarily alike, were not at first discriminated. E. B. P.]

[Rabai, May 9, 1908. I saw a good many *Euralia deceptor* and *kirbyi* last Saturday, which was a fine day after rains earlier in the week, but they were mostly in bad condition and the better specimens were flying high. I also caught two or three *Euxanthe wakefieldi*, but they were none of them perfect, and I did not keep any.]

Euxanthe tiberius, Gr.-Sm., ♀ (Plate XXVII, fig. 3). The female of this species should also be included in the combination, although the male is very distinct. It is true, however, that the conspicuous fulvous patch on the inner part of the fore-wing at once distinguishes the female from all the other members, and is a prominent feature even on the wing. The development of the white patch on the hind-wings is the more striking because of its total absence in the male. As a further mimetic modification of the female, all the pale spots in the fore-wing are larger and whiter than in the male. I am strongly of the opinion that *E. tiberius* itself must be regarded as a protected species and a Müllerian mimic. Unless thoroughly disturbed, it is a very sluggish insect and is most conspicuous on the wing, especially in the deep shade which it loves. It is true that the texture of the wings is much softer and more readily torn than that of species like *A. niavius dominicanus* and *ochlea*, but the body is extremely tough, and I have found it exceedingly difficult to kill by pressure between the finger and thumb,—even more so than *Danaida (Limnas) chrysippus*, L.

[Rabai, May 1, 1906. I have captured a fine *Euxanthe* [*E. tiberius*] which is quite new to me. This was a great surprise, as I have worked this district pretty hard, and

it is not an insect one would be likely to pass over. I have taken in all three specimens which I send you, two of them being not quite perfect, whilst the third is as good a specimen as one could wish for. All three were taken in the same locality, on the site of the old capital of the Rabai tribe (called *New Rabai*), which has long been deserted, though it is still resorted to for sacrifices and other superstitious practices. All three specimens were taken in deep shade, and its flight seems heavy and feeble, but as, in each case, I captured the specimen at first sight I cannot say whether it would prove more active if it were alarmed. I should say that this locality occupies the top of a high hill just opposite the present town of Rabai, with a deep ravine between, whilst on the other side there is a precipitous descent of about 700 ft. almost to sea-level. It is in part covered with forest and seems a splendid locality.]

[*Rabai*, July 29, 1906. All the specimens of *E. tiberius* but one have been taken in almost exactly the same spot. During the daytime it rests on trees with its wings upright, and if alarmed goes off at a good rate, and dodging amongst the trees is soon lost to sight; but it seems to be an insect of sluggish habits, and I have never seen them sporting together in the manner of *E. wakefieldi*. I took one specimen which had evidently retired for the night resting on the under side of a leaf with its wings hanging down.]

[*Rabai*, May 9, 1908. The dry hot weather lasted on till the middle of April when all insects were rather scarce. It was noticeable that *Euxanthe tiberius* was much more wary and difficult to take than usual during this time. When on the alert it has a provoking habit of going off in the forest and settling on a tree-trunk some 20 or 30 yards away, and then when you stalk it with great care it waits till you are nearly within reach and then goes off and repeats the performance.]

Aterica galene, Brown, ♀, may also be associated with this among other combinations. The species is common in woodland and forest areas on the Coast hills, where the intense light and shade make it anything but conspicuous when settled on the ground. The colour of the pale patch on the hind-wing of the female varies considerably, being sometimes white. The individuals with an ochreous patch fall naturally into the *Amauris ccheria* and *albimaculata*

centred combination (see pp. 511, 512). The under side is of course procryptic, so that it can hardly be regarded as a distasteful insect. Professor Poulton has pointed out (see p. 505) that there are certain features in the markings of the fore-wing which are apparently secondarily associated with the *Pseudacræa* and *Euralia* of this combination.

1. *The Relative Abundance of the members of the Amauris ochlea-centred Combination.*

The relative abundance of the members of this combination varies a good deal in different localities and stations, as was seen to be the case with regard to the *A. niavius dominicanus* combination. At Rabai the two *Euralias* predominate in the wooded country, and are even more in evidence than the primary model, whilst on a tour further north in the Giriama country I found *P. lucretia expansa* the most numerous member, especially at Mangea.*

[Rabai, August 29, 1908. I am sending you two *Euralia kirbyi* and one *Pseudacræa lucretia*, taken in Dida Forest, which is a large area of low dense forest, a little south of Kaembeni on the way to Jilore. The *Euralia* was quite common, and I netted other specimens which were not good enough to keep, but for the whole distance; some 8 miles, I never saw *Amauris ochlea* at all. In fact, I have found that both the *Amauris* are more local than the *Euralias*, though very abundant in places. Moreover, I have seldom seen them flying with either the *Euralia* or the *Pseudacræa*, which is of considerable interest in view of the fact that the mimics resemble each other more closely in some respects than either does the primary Danaine model.]

2. *Secondary Resemblance between the Nymphaline members of the Amauris ochlea-centred Combination.* E. B. P.

I have been much struck with the apparently strong secondary likeness between *Pseudacræa lucretia expansa*, *Euralia deceptor*, and *E. kirbyi* so often taken by the

* [A considerable number of the members of this and the *dominicanus*-centred combination from Coast localities N. of Rabai, and also from Taveta, and a few from Taita and Kilimanjaro, have been presented by the author to the Hope Department. It has not been thought necessary to tabulate them in view of the more complete records from Rabai printed on p. 496; but it is well to point out that these specimens from additional localities also afford strong evidence that the species occur at the same places and are often seen upon the wing together. E. B. P.]

author in the same locality and on the same or nearly the same date. The two *Euralias* are so much alike in pattern that they might easily be mistaken even in the cabinet, while their resemblance to the pattern of the *Pseudacraea* is also very marked. There can be little doubt that this is not an incidental result of resemblance to the same Danaïne model, but that it is a genuine case of secondary mimicry. The most characteristic element in the pattern of the *Pseudacraea* is a curved series of white spots crossing the fore-wing and forming together a marking which suggests a thick "comma." The concave side of the curve is directed towards the base of the wing, and the point of the "comma" rests in the cell. This well-marked feature occupies nearly the position and is mimetic of the chief white marking in the fore-wing of *Amauris ochlea*. It is, however, of a more peculiar and characteristic shape in the mimetic *Pseudacraea*, and the two *Euralias* which resemble it, than in the model. Hence there can be little doubt about the existence of a true secondary approach between these representatives of the two Nymphaline genera. The question furthermore arises as to whether *Pseudacraea* or *Euralia* has acted as the model. Although all three species appear to be common in the neighbourhood of Rabai, it is probable that *Pseudacraea lucretia expansa* is the model followed by its Nymphaline co-mimics. The secondary resemblances described above are well shown in Figs. 4-6 of Plate XXVII. The peculiar marking, with some modification, occurs in other sub-species of *lucretia*, between them covering a very wide range—in *tarquinia*, Trim., of the south-east; in the abundant form (with points of resemblance to both *tarquinia* and *expansa*) from the N.E. of the Victoria Nyanza; and in *lucretia lucretia* of the West Coast. The two *Euralias* have a far more limited distribution, being apparently confined to areas where the marking reaches its most characteristic development in the *Pseudacraea*. There is no doubt, as the author pointed out to me, when we were studying the Hope Collection together, that the central markings in the fore-wing of *Euralia dubius*, Pal. (neighbourhood of the Victoria Nyanza to the W. Coast), tend to exhibit a peculiar curve which may indicate affinity with *E. deceptor* rather than the usually accepted affinity with *E. mima*,* Trim., but the relation-

* Upon the under surface, *Euralia dubius* appears to resemble *E. mima* much more closely than it does *E. deceptor* and *E. kirbyi*.

ship between the markings does not support the conclusion that the feature is primitive in the Euralias. In fact *E. dubius* has itself been so strongly modified by mimicry of western species of *Amauris*, that the marking under consideration usually exhibits only a slight although recognisable resemblance to that of *E. deceptor* and *E. kirbyi*.

The peculiar curve in the chief band of white spots crossing the wing of the female *Eucanthë tiberius* (shown on Plate XXVII, fig. 3) has also probably been produced by secondary mimicry either of the *Pseudacræa* or the *Euralia* which occur in the same locality. The case of the widespread Nymphaline *Aterica galene* with its variable female is more puzzling. But here also we find in both sexes and in all forms of the female the same peculiar curve in the chief band of pale spots crossing the fore-wing. If this marking has been affected by secondary mimicry the species has at any rate carried it far away from the area where the most characteristic development is reached by the model. This however would not be the only example of *A. galene* ranging beyond its model. Thus it is shown on p. 512 that the *Amauris echeria*-and-*albimaculata*-like form of the female—and in this case the mimetic resemblance cannot be doubted—occurs in localities near Mom-basa, where its Danaine model is unknown. The two dark spots (generally fused in male, often in female, occasionally very minute or perhaps altogether wanting) in the cell of the hind-wing under side may possibly indicate resemblance to the well-known group of spots occupying this position in the *Pseudacræa*. E. B. P.

c. Outlying members of the Black-and-White Eastern
Amauris-centred Combinations.

Nymphalinxæ. Mr. G. A. K. Marshall has shown that the African species of the genus *Neptis* have certain features which indicate that they should be regarded as outlying members of this large and complex combination. He has also brought forward evidence which points to the conclusion that they are themselves distasteful. There are three species of this genus which I have taken commonly:—*N. agatha*, Stoll.; *N. marpessa*, Hoppf., and *N. melicerta*, Drury. All these have a wide distribution and are commonly met with. The most abundant species is *N. agatha*, and there is no doubt that, in the distribution of its black

and white markings, it approaches most nearly to the central members of the group. Moreover it is extremely variable in size, some of the largest females nearly equaling *Amauris ochlea*, whilst the smallest males are no larger than average specimens of *marpessa* and *melicerta*. The species of *Neptis* are very conspicuous on the wing and have a leisurely floating flight, but they are very active and are not taken nearly so easily as one would be led to expect.

Besides these three species of *Neptis* we have two species of another Nymphaline genus which strongly resemble them, i. e. *Neptidopsis ophione*, Cram., and *N. fulgurata*, Boisd., sub-sp. *platyptera*, Rothsch. and Jord. Now although these belong to a genus so distinct in structure, being in fact *Eurytelids*, yet during life they bear a very strong resemblance to the genus *Neptis* both in appearance and in habits. *N. ophione* is certainly an abundant species, and I should regard *N. fulgurata platyptera* as quite common, though, as far as my experience goes, its range is far more restricted.

Associated with these species of *Neptis* I should place a most interesting Lycaenid, *Alaena picata*, E. M. Sharpe, which departs widely from the style of colouring usual in the family, and assumes the strongly contrasted black and white markings characteristic of this great combination. This species is not common, but I think it possible that it may frequently be overlooked on account of its strong resemblance to a small *Neptis*. It is true that the details of pattern differ somewhat from those of any species of the genus *Neptis* with which I am acquainted, but I have found the Lycaenid very difficult to distinguish on the wing. Its flight is even more feeble and may exhibit something of the "floating" appearance of *Neptis*, while it frequents exactly the same localities: even in size it approaches the smaller specimens of e.g. *N. melicerta*. Moreover, the genus *Alaena* has been shown by Mr. G. A. K. Marshall to be in all probability distasteful, and this renders it likely that the species is a Müllerian member of the combination.

[Rabai, May 1, 1906.]

This species [*A. picata*] when taking its longer flights looks almost like a moth, moving its wings with considerable rapidity.]

[Address and date lost.

This *Lycænid* [*A. picata*] bears a curious resemblance to a small *Neptis*, but its flight is much more feeble and the "floating" character much less pronounced, so that it is generally recognisable although with difficulty. It also rests, as do most of its allies, with its wings hanging down, which at once betrays it.]

Before leaving *Neptis* it would be as well to refer to another species of the same genus, *N. incongrua*, Butl., which has the same contrasted black and white markings distributed in a manner different from that of Ethiopian species generally. Its peculiar pattern produces a close resemblance to *Eurytela hiarbas*, Drury, which is found in the same localities. The first specimen of *N. incongrua* which I captured quite deceived me, and it was not until I had the butterfly in the net that I discovered that it was not *E. hiarbas*. Now that I am better acquainted with both species it is not likely that I should make any such mistake even when the insects were on the wing, but there is no doubt that the resemblance is more than accidental. Mr. Marshall has recognised the resemblance of an allied species of *Neptis* in S.E. Rhodesia to *Eurytela hiarbas*.*

Acraëinæ. There are also the females of two large abundant *Acraëinæ* which, with their mimics, should, no doubt, be looked upon as outlying members of this combination. The general effect of their pattern certainly suggests that of the black and white species of *Amauris*, although, as in the genus *Neptis*, the details of the marking are obviously different. The central species of this

* Before leaving the *Nymphaliniæ* I should wish to draw attention to a possible case of mimicry in the genus *Charaxes*. Mr. G. A. K. Marshall has suggested possible cases of mimicry of one *Charaxes* by another, and I think we have a parallel example at Taveta.

When looking through the series of *C. etheocles*, Cram., at Oxford, I found that the two female specimens I took at Taveta differed from those Mr. Wiggins obtained in the region of the Victoria Nyanza in two respects, i. e. the fulvous colouring on the fore-wings was more extensive, and the white bar in the hind-wings was much narrower. In both these differences the Taveta specimens approach *C. saturnus*, Butl., and it is noteworthy that whereas *C. saturnus* was common at Taveta, yet Mr. Wiggins did not send home a single specimen from the Victoria Nyanza in his very fine series of *Charaxes* from this region.

group is the female of *Planema aganice*, Hew., form *montana*, Butler, which is found commonly in many localities in East Africa. Associated with it are the white-marked forms of the female of the common *Acræa csebria*, Hew., and of *A. carmentis*, Doubl., which I have once received from Kilimanjaro. I have also once taken the female of a *Pseudacræa*,* probably the eastern representative of the western *P. hirce*, Drury. This white-marked female is a beautiful mimic of the female *Planema*. These three species are so similar in pattern and flight that I do not think it is possible to distinguish them on the wing. They all have the characteristic leisurely flight of the *Acræinæ*, and, from their large size and strongly contrasted black and white colouring, are distinctly suggestive of the *Amauris niavius dominicanus*-centred combination. Other mimetic resemblances of and between the males of these two common *Acræas* will be described on p. 523. They are considered with the other *Acræa*-centred combinations, because the pattern of the males does not, like that of the females, enter into a distant relationship with any of the *Amauris*-centred associations.

Another outlying member belonging to the same sub-family is the female of *Acræa satis*, Ward, which I have found not unfrequently in the Coast district, and even on Mombasa island. Here again, although the details of marking are very different, in size and colour the species certainly approaches this great black and white combination.

Pierinæ. Professor Poulton has suggested that *Gluto-phrissa saba*, Fab., ♀, should be regarded as an outlying member of the combination, but as far as my experience goes this species is always an unmistakable Pierine, and does not resemble the other members in its habits or appearance.†

Papilioninæ. I am somewhat more doubtful as to the position of *Papilio philonoe*, Ward, which certainly has a floating flight. It bears more resemblance to *Pseudacræa lucretia expansa* than to any other member of the combination, but the white areas are much more extensive and it can always be easily recognised.

* *Pseudacræa rogersi*, sp. nov. See Appendix, p. 549.

† Mr. Roland Trimen suggested in 1881 (Proc. Ent. Soc. Lond., p. vii) that the ♀ *saba* might be a mimic of the widely-spread and evidently protected African Hypsid moth, *Nyctemera apicalis*, Walk.

II. *Amauris echeria*-and-*albimaculata*-centred Combination from the Kikuyu Country.

My experience of this interesting combination has been chiefly derived from recent visits to the Kikuyu country, although I have also encountered it on and near Kilimanjaro. The following captures at various localities in the Kikuyu country will give some idea of the relative abundance of the models and their various mimics.

(a) *Weithaga*.

The numbers of specimens of this group taken at Weithaga have been arranged in the following tabular form by Professor Poulton.

Weithaga.	DANAINÆ. Primary model (<i>echeria</i> not taken).	NYMPHALINÆ. Mimic, with secondary resemblance to <i>Acræa johnstoni</i> .	ACRÆINÆ. Mimic.	PAPILIONINÆ. Mimic.
DATES.	<i>Amauris albimaculata</i> .	<i>Neptis woodwardi</i> .	Forms of <i>Acræa johnstoni</i> .	♀ of <i>Papilio echerioides</i> .
1906.				
Aug. 11 . .	...	1 ♀ rather worn. Pl. XXIX, fig. 2.	...	...
Aug. 13 . .	...	1 ♂ a little worn.	1 ♂ <i>fallax</i> — worn.	...
Aug. 16 . .	2 ♂	...	1 ♂ <i>fallax</i> — worn.	...
Aug. 18 . .	...	1 ♂ worn.	1 ♂ <i>fallax</i>.	...
Aug. 22 . .	...	...	...	1 ♂
1907.				
March 9 . .	...	...	...	1 ♂
March 16 . .	1 ♂	...	1 ♂ <i>fallax</i> — worn.	...
March 30 . .	1 ♂	...	2 ♂ 1 ♀ <i>fallax</i> .	1 ♂ chipped. 1 ♀ Pl. XXVIII, fig. 4.
April 4 . .	1 ♂	...	...	...
April 5 . .	...	...	1 ♂ <i>proteina</i> —worn.	...
April 13 . .	3 ♂, 1 ♀	...	...	...
April 18 . .	...	1 ♂ chipped.	...	...
April 20 . .	1 ♂	...	...	...
May 10 . .	...	1 ♂ a little worn. Pl. XXIX, fig. 1.	...	...
May 11 . .	1 ♂, 1 ♀	...	...	...

Unnoted specimens in good condition.

All the mimics have white spots in fore-wing and yellowish patch in hind except the males of the *fallax* form of *A. johnstoni*, Godm., which have yellowish spots in fore-wing. [The *fallax* are very interesting in that they resemble the two specimens captured by Mr. and Mrs. S. L. Hinde, one at Fort Hall and the other above the Goura River, and described as trending in the direction of *johnstoni* in Trans. Ent. Soc. Lond., 1906, p. 309. E. B. P.]

These captures compare in an interesting manner with those made by C. A. Wiggins, near the N.E. shores of the Victoria Nyanza, and described by Mr. S. A. Neave, M.A., B.Sc., F.E.S., in Trans. Ent. Soc. Lond., 1906, pp. 213, 214.

(b) *Nairobi*.

1906, Aug. 30. *P. echerioides*, Trim., 1 ♂.

1907, Feb. 2. *Acræa johnstoni*, Godm., f. *semifulvescens*, Oberth., 1 ♂ slightly worn.

Feb. 4. *P. echerioides*, 3 ♂, 2 slightly worn; the third represented in Plate XXVIII, fig. 5.

P. echerioides, 1 ♀, worn, and right hind-wing notched.

P. jacksoni, E. M. Sharpe, 1 ♂. Represented in Plate XXVIII, fig. 3.

P. dardanus, probably sub-sp. *tibullus*, 1 ♂. Represented in Plate XXVIII, fig. 7.

P. dardanus, probably sub-sp. *tibullus*, 1 ♀ of the *cenæa*, Stoll., form, somewhat transitional towards the *hippocoön* ♀ f., worn and much chipped, apparently by birds. Represented in Plate XXVIII, fig. 6.

Acræa johnstoni, form *flavesceus*, Oberth., 1 ♂, worn.

On this last-named day many other males of both *P. echerioides* and *P. dardanus* were seen and several females of the *hippocoön* form of the latter. It is interesting to note that although the model was not taken, no less than three species of *Papilio* possessing *echeria-albimaculata*-like females were captured on Feb. 4.

(c) *Kijabe*.

1906, Aug. 3. *Amauris albimaculata*, Butl., 1 ♂. Represented in Plate XXVIII, fig. 1.

Papilio jacksoni, 6 ♂, 3 ♀.

1 ♂ with right hind-wing with anal half shorn off; rather worn.

1 ♂ and 1 ♀, each with chip in left hind-wing, the ♂ a little worn, the ♀ fresh.

Of the rest, 2 ♂ and 2 ♀, a little worn; the most perfect ♀ is represented in Plate XXVIII, fig. 2.

Aug. 6. *P. jacksoni*, 2 ♂ and 2 ♀. Both females worn, one slightly.

1907, Feb. 6. *P. jacksoni*, 1 ♂ and 2 ♀. Both females worn, one slightly, and both chipped near anal angle of hind-wing.

(d) *Mogoiri* and *Tuso*.

1907, April 29. *Amauris albimaculata*, 2 ♀, rather worn.

March 1. *A. albimaculata*, 1 ♀, much worn.

Neptis woodwardi, E. M. Sharpe, 1 ♂, worn, hind-wing patch white.

March 2. *N. woodwardi*, 2 ♂, one a little worn.

1. *The Primary Danaine Models.*

In Kikuyu *Amauris albimaculata*, Butl., is the dominant species and all my specimens belong to it, whereas on Kili-manjaro *Amauris echeria*, Stoll., is also commonly found, as is usually the case where *A. albimaculata* occurs. It is quite probable that *A. echeria* exists in Kikuyu, but it must have been comparatively rare in the under-mentioned localities at the times when I visited them.

2. *Nymphaline Mimics.*

I have never met with *Euralia mima*, Trim.* and the British East African forms of *Pseudacraea lucretia* seem to fall more properly into the group of which *A. ochlea* is the centre. Certain varieties of the female in the closely allied sub-species *tarquinia* from Natal are, on the other hand, excellent mimics of *Amauris echeria* and *albimaculata*.

A form of the female *Aterica galene* appears to be a well-marked member of this group, while the male is a more outlying member. Although probably always mimetic this species is very independent of the local

* When glancing over the splendid collection of Congo butterflies in the Brussels Museum, under the kind direction of Monsieur Severin, I noticed several *echeria*-like specimens of *Euralia dinarcha*, Hew.—the var. *barteloti*—Grose-Smith, from Beni Bendi, in the central part of the State. I was astonished at this because it was fairly certain that the well-known models did not exist in that locality. Turning to the *Danainæ*, it was at once evident that a form of *Amauris egialea*, Cram., with an ochreous hind-wing patch, occurred at the same locality and supplied the model. E. B. P.

presence of its models, and the specimens of this particular form of the female with a brown patch on the hind-wing were taken in the coast localities from which the Danaïne model is in my experience absent, although it is common near Voi, 100 miles inland. These captures of *galene* in the coast localities were as follows:—Kaya Kauma (Aug. 21, 1903), Rabai (May 10, 1906), Jilore (July 16, 1906), Ndlovuni (July 21 and Oct. 5, 1906).

[Address and date lost.

Aterica galene bears some superficial resemblance in colour to *Amauris albimaculata*, but its habits are quite different. Like all this group it is fond of sitting on the ground in paths of woods where there is much light and shade. If disturbed it merely flies a little way and settles again.

Acræa johnstoni and *Neptis woodwardi* bear somewhat the same relation to this group as *Planema aganice* and its *Pseudacræa* mimic bear to the black white and *A. niavius dominicanus* group, viz. the relation of a pair of secondarily associated butterflies which are also members of a large combination surrounding a primary Danaïne model. Both *Acræa* and *Neptis* resemble each other in habits, and on the wing it is difficult to distinguish them. Their appearance is, generally speaking, not dissimilar from that of the primary model in spite of its much greater size.]

[Rabai, Sept. 30, 1906.

Of those new to me [in Kikuyu] the most interesting was a species of *Neptis* [*N. woodwardi*] which seems to have been modified so as to resemble *Acræa johnstoni*, though the resemblance is not very close.]

Professor Poulton has added to this account of the Nymphaline mimics of the *Amauris ccheria*-and-*albimaculata* centred combination a comparison of the specimens of *Neptis woodwardi* captured far to the W. of the Rift Valley with those taken by me just E. of it.

(a) *Specimens of Neptis woodwardi from the E. of the Rift Valley compared with those from the W.* E. B. P.

It is very interesting to compare the 8 specimens of *Neptis woodwardi*, E. M. Sharpe, obtained by Mr. St. Aubyn Rogers on the eastern heights overlooking the Rift Valley, with the equal number captured by Mr. C. A. Wiggins

near the N.E. shores of the Victoria Nyanza, far to the W. of the Valley. Mr. Wiggins obtained 7 specimens from the Tiriki Hills, about 20 miles north of Kisumu.* These hills are covered with dense forest, and the collection was made at a height of about 5100 ft. An eighth specimen was captured by Mr. Wiggins at Kakamega's (5500 ft.) near Mumias on the Uganda Railway, about 15 miles N.E. of Kisumu—a locality which did not come within the scope of Mr. Neave's paper in the *Novitates Zoologicae*. The 8 specimens were captured by Mr. Wiggins on the following dates:—

Kakamega's, Dec., 1902	...	one male.
Tiriki Hills, Feb. 26, 1903	...	two males: one represented in Pl. XXIX, fig. 3.
Tiriki Hills, Feb. 27, 1903	...	one female: represented in Pl. XXIX, fig. 4.
Tiriki Hills, Mar. 17, 1903	...	two males, one female.
Tiriki Hills, Mar. 19, 1903	...	one male.

Corresponding with the fact that Mr. Rogers' specimens came from the E. of the Rift Valley in a country where the influence of the dominant *Amauris albimaculata* (and perhaps *echeria*, see p. 511) is at its highest and the mimetic combination surrounding it of the greatest size, the individuals of *Neptis woodwardi* are distinctly better mimics than those obtained by Mr. Wiggins in an area where the two species of *Amauris* are less dominant and attract a smaller association of mimetic species (compare Figs. 1 and 2 with 3 and 4 on Plate XXIX). The four white spots in the fore-wing are larger, and generally much larger, in the eastern forms. A minute fifth white spot close to the costa of the fore-wing is present in all the E. specimens, absent from all the W. males except the one captured on March 19. All possess this marking upon the under surface, although in one of the Tiriki males it is exceedingly minute. The feature upon which the mimetic resemblance chiefly depends is the ochreous bar crossing the hind-wing. This is so narrow in the W. males (Plate XXIX, fig. 3) that they can hardly be said to belong to the *echeria*-centred combination at all. The two W. females

* S. A. Neave in Nov. Zool. Vol. XI, 1904, pp. 323 and 350, 351. See also Trans. Ent. Soc. Lond., 1906, p. 214, where the same author points out that *Neptis woodwardi* is an outlying member of the *A. echeria*-and-*albimaculata*-centred combination.

(Plate XXIX, fig. 4), however, in which the bar is much wider and the white spots in the fore-wing much larger, are distinct members of the combination, with a strong secondary approach towards the *proteina*, Oberth., form of *Acræa johnstoni*. The E. males (Plate XXIX, fig. 1) resemble these two W. females in both size of spots and breadth of the ochreous bar, so that they too are well-marked members of the association. The single E. female (from Weithaga) is developed still further in the same direction (Plate XXIX, fig. 2), being as far in advance of the E. females as these are beyond their own males.

It is probable that *Neptis woodwardi* has been developed from a form resembling *N. incongrua*. As regards the reduction of the spots in the fore-wing and the loss of the fifth spot the W. males are more specialised than the E. As regards the development of an ochreous patch out of a narrow band the E. males and especially the female are the more specialised. In *N. incongrua* the numerous white spots form an irregular bar across the fore-wing. By the loss of certain spots the bar-like appearance disappears in *N. woodwardi*, while just those elements are retained which bring about the mimetic resemblance to *Acræa johnstoni*. In the same manner the narrow white bar crossing the hind-wing of *incongrua* is withdrawn towards the base, broadened, and transformed into ochreous in *woodwardi*,—all of which changes are in the directions of the Acraeine secondary and Danaïne primary models. The hind-wing bar of *woodwardi* from both E. and W. of the Rift Valley occasionally retains more or less of the white ground of *incongrua*. In such examples the costal end of the bar is generally tinged with ochreous. E. B. P.

3. *Acraeine Mimics.*

The resemblance of the *proteina*, *flavescens*, and *fallax* (= *kilimandjara*, Oberth.) forms of *A. johnstoni* to the *echeria-albimaculata* models was described and figured by Professor Poulton in 1906,* together with the likeness of the forms *fulvescens*, Oberth., and *semifulvescens*, to very different Danaïne and Acraeine models. The mimicry of *Amauris echeria* by the commonest forms of *A. johnstoni*, viz. *proteina* and *flavescens*, had been suggested by the same naturalist as early as 1897.† His 1906 memoir

* Trans. Ent. Soc. Lond., 1906, pp. 299-311, Plates XXI, XXII.

† Report British Association, Toronto, 1897, pp. 688-691.

above referred to, dealt with the material obtained by me in Taveta and from the slopes of Kilimanjaro, but no complete list of specimens is given in it. Later captures have so far increased the series of this protean species as to make it worth while to publish the whole list from these localities and from Dabida Hill in the Taita district. It will be thus possible to gain some idea of the relative abundance of the various widely separated forms.

(a) *Tabular statement of the forms of *Acraea johnstoni* captured at Taita, Taveta, and Kilimanjaro, May 1904-Jan. 1906.*

LOCALITY AND DATE.	Forms of <i>Acraea johnstoni</i> , Godm. (including <i>fallax</i> , the eastern representative of <i>A. lycoa</i> , Godt.).					
	<i>proteina</i> .	<i>fallax</i> ♀.	<i>fallax</i> ♂.	<i>flavescens</i> .	<i>semi-fulvescens</i> .	<i>fulvescens</i> .
TAITA, DABIDA. 1904.						
May 25 . .	...	...	...	1 ♂ W	...	...
May 26 . .	1 ♀ W	...	...	...	...	...
May 30 . .	...	...	...	1 ♂	...	1 ♂
May 31 . .	1 ♂ W -	...	...	...	...	...
June 8 . .	1 ♂	...	...	...	...	...
TAVETA. 1905.						
April 21 . .	1 ♀	...	...	1 ♂	...	...
May 15 . .	...	...	...	...	1 ♀ F ₁	...
KILIMANJARO.						
May . . .	1 ♂ W	...	...	...	...	1 ♀ W +
KILIMANJARO, MAMBA STATE, about 5000 ft.						
Sept. 15 . .	...	...	1 ♂ W -	...	...	...
Sept. 21 . .	...	...	1 ♂	...	...	...
Sept. 26 . .	1 ♂ W	...	1 ♂ W	...	1 ♂ F ₂	...
KILIMANJARO.						
Dec. 15-31 .	...	2 ♀ 1 W 1 F ₃	1 ♂ F ₄	3 ♂ 2 W 1 F ₅	1 ♂ W	1 ♂ F ₆
1906.						
Jan. 5-16 . .	2 ♂ W *	...	2 ♂ W -	...	2 ♂ W	3 ♂ 1 W 1 W -
Totals . . .	6 ♂ ; 2 ♀	2 ♀	6 ♂	6 ♂	4 ♂ ; 1 ♀	5 ♂ ; 1 ♀

* One captured Jan. 26-31, 1906.

The following specimens are figured by Professor Poulton in *Trans. Ent. Soc. Lond.*, 1906, p. 281.

F 1	figured in <i>Trans. Ent. Soc. Lond.</i> , 1906 :	Plate XXII,	Fig. 2 ^a .
F 2	" " "	Plate XXI,	Fig. 3 ^a .
F 3	" " "	"	Fig. 2 ^a .
F 4	" " "	"	Fig. 1 ^a .
F 5	" " "	"	Fig. 1 ^b .
F 6	" " "	"	Fig. 4 ^a .

The tabulated examples of *flavescens* possessed very pale ochreous spots in the fore-wing, so that it was difficult to distinguish worn specimens from *proteina* with its white spots. Omitting the consideration of *fallax*, which may be a distinct species, it is seen by this list that *semifulvescens* is by no means rare as compared with the other two forms.

[So far as this comparatively short list enables us to judge, *fulvescens* is nearly half as numerous and *semifulvescens* about a third as numerous as the combined *proteina* and *flavescens* forms. This means that they are far from rare, and helps us to understand the probable secondary mimicry of *fulvescens* by the under side of the female *Acræa uvui*, Grose-Smith. A single specimen of the female of this small *Acræa* was captured in Mamba, Kilimanjaro, on September 25, 1905. The under side of the specimen differs entirely from that of the extremely abundant male and from other females of its group, in the overspreading fulvous tint which tends to obliterate the markings, producing at the same time a considerable superficial resemblance to the *fulvescens* form of *A. johnstoni*.

The *fulvescens* form, in addition to its mimicry of the *dorippus*, Klug, form of *Danaïda chrysippus*, L., resembles the *daira* form of *Acræa encedon*, L. Both *dorippus* and *daira*, Godm. and Salv., are the dominant forms of their respective species. The local form of *Acræa doubledayi*, Guér., of which a male was taken on Kilimanjaro, January 26-31, 1906, also much resembles *daira* and *fulvescens*, and would probably be indistinguishable from these when upon the wing. E. B. P.]

[Address and date lost.

The two different forms of this [*Acræa johnstoni*] resemble other protected species, the commoner forms [*proteina* and *flavescens*] being very like *A. albimaculata* which

is common on the Taita hills: the other form [*fulvescens*] I thought to be a different species until I perceived that the white spots on the fore-wing were traceable though almost obsolete. It is very difficult to distinguish it from *Acræa encedon* on the wing, but it is I think both brighter and lighter in colour. It is more active than most *Acræas*, but shares with these their remarkable resistance to Potassium cyanide in the killing bottle.]

[Mombasa, April 5, 1905.]

A. johnstoni I have only found on the hills at 3000 ft. upwards. I did not get it at Taveta, or indeed *A. albimaculata*, which also seems a hill insect.]

[It will be seen by reference to the table on p. 515 that soon after the above letter was written, forms of *A. johnstoni* were taken at Taveta. E. B. P.]

4. *Papilionine Mimics*. The mimetic females of the three species of *Papilio* are well shown, two-thirds of the natural size, on Plate XXVIII, together with their non-mimetic males and chief Danaine model. It is seen that the females of *Papilio jacksoni* (Fig. 2) and especially of *P. echerioides* (Fig. 4) are more perfect mimics of the *Amauris* (Fig. 1) than the *cenæa* female form (Fig. 6) of *P. dardanus* (*merope*), probably sub-species *tibullus*. The latter happens to be a very imperfect specimen of a variety tending towards the *hippocoön* female form and rather a poor mimic. The series of specimens represented in Plate XXIV of this year's Transactions (1907) shows that the mimicry of the *cenæa* form is usually better than in the example here figured. I have already alluded to the fact that all three *Papilio* mimics were taken at Nairobi on the same day (see Figs. 3, 5, 6 and 7 on Plate XXVIII), though one species (*P. jacksoni*) was represented by the male only which is not mimetic of *Amauris*. Another point of interest is the local preponderance of *Papilio jacksoni* where it is found. This preponderance at Kijabi is, I think, fairly represented by the series obtained there, and suggests that the *Papilio* may itself be distasteful to certain enemies, but gains advantage in the adoption by its female of a well-known Danaine pattern. Although a mimic, the *Papilio* may in its own habitat far outnumber the model, which however has a much greater range and is of course as a whole an infinitely more abundant insect.

In nature the *Papilio echerioides* female is much nearer

to the primary model than the other female *Papilio*s, and, were it not for the characteristic habit of hovering nervously over a flower, it would be very difficult to distinguish it from the *Amauris*. This close resemblance is especially remarkable when it is remembered that the under surface is mimetic of a very different model—*Planema aganice*.

I have never met with the *cenca* form of the ♀ of *P. dardanus* sub-species *tibullus* at all frequently, although I have taken it at Taveta, e. g. on August 4, 1905. Furthermore, three specimens were brought me from Kilimanjaro, where it is probably common. Two of these are distinguished by the yellow colour of the disc of the hind-wing and some of the fore-wing spots, suggesting affinity with the primitive *trimeni*-like *cenca* female forms of *Papilio polytrophus* from the Kikuyu escarpment.

I have also received males of *Papilio ccherioides* from the same locality and have taken them at Taveta and in Taita.

[Mombasa, April 5, 1905.]

On Dabida [Taita] I have only taken *Papilio ccherioides* above 3000 ft.]

It would be of great interest to obtain the female from these localities, but there can be no doubt that it is the same form as that captured in the Kikuyu country. Dr. Karl Jordan, who has seen the specimens, informs me that they are not quite the same as typical *ccherioides* from Natal, Gazaland, etc., but are transitional between this and the Abyssinian sub-species, *oscuri*, Rothschild and Jordan.

5. *Moth Mimics*.—*Alctis monteironis*, Druce, is an abundant species in North Kikuyu and, owing to its slow flight, a most conspicuous insect. It frequents more open country than the *Amauris*, but they may often be seen flying together. The resemblance is not strong on the wing, as the large pale areas of the moth are very prominent, and it is probable that it is itself a protected species, and has been but little modified by its association with the Danaïne model.

(a) *Further Notes on Moth Mimics*. E. B. P.

The day-flying moth, *Alctis monteironis*, Druce, which looks so entirely different from the *Amauris* in the cabinet, is, Mr. Marshall informs me, quite a good mimic

of *Amauris lobengula*, E. M. Sharpe, when upon the wing. It occurs plentifully in British East Africa in localities where *Amauris echeria* and *albimaculata* are dominant. Thus I have received many from the neighbourhood of Fort Hall captured by my kind friends Mr. and Mrs. S. L. Hinde. Colonel Manders, who captured it with one of the *Amauris* models at Delagoa Bay, informs me that he thought it a good mimic on the wing, but when the set species were compared the very different patterns led him to conclude that he had made a mistake. The whole Geometrid genus *Aletis* is undoubtedly highly distasteful. Its ordinary pattern, e. g., that of *A. helcita*, Linn., of the West Coast and *A. libyssa*, Hopff., of the East, is probably the centre of an important combination (see p. 522) associated with that which surrounds *Danaida chrysippus*, but possessing strongly-marked independent aposematic elements of its own. In spite of these latter, the association with *chrysippus* has always been looked upon as synaposematic—a conclusion now strongly confirmed by this undoubted resemblance upon the wing of another species of *Aletis* to another Danaine model.

Aletis monteironis only differs from *A. libyssa* in the tint of the ground colour, a peculiar ochreous in the former, a brilliant fulvous in the latter. *A. monteironis* is probably a form of *A. libyssa* which has undergone a change in the tint of the ground colour in areas where the *echeria* (or *lobengula*) and *albimaculata* models are dominant. In spite of the special resemblance to *A. lobengula* observed by Mr. Marshall the distribution of the moth clearly indicates association with both the other allied forms of *Amauris*, viz. *echeria* and *albimaculata*. E. B. P.

III. *Danaida* (*Limnas*) *chrysippus*-centred Combination in British East Africa.

1. *The Primary Danaine model.* In East Africa generally the form *dorippus*, Klug (*klugii*, Butl.), is far more common than the type form, probably in the proportion of ten to one.

D. chrysippus seems very subject to the attacks of Dipterous parasites. Out of 10 pupæ which I bred from larvæ at Weithaga no less than 9 were destroyed by the larvæ of a fly, which has been identified by Mr. E. E. Austen as belonging to the genus *Blepharipoda*, of the *Tachinidæ*. These emerged on various dates in April,

1907. Thus my experience in British East Africa confirms that of Mr. G. A. K. Marshall in Rhodesia* and of Colonel J. W. Yerbury at Aden,† and supplies further evidence in refutation of Erich Haase's‡ assumption that the immunity of specially protected forms is absolute and defends them from the attacks of parasitic foes as well as vertebrate enemies.

[Taveta, July 5, 1905.]

D. chrysippus, for several months past, as far as I have seen, has been always of the *klugii* form, and I have not seen 6 specimens of the type form in 6 months.]

[Rabai, May 1, 1906.]

Have you any reason to believe that the *klugii* form is spreading at the expense of the type form of *D. chrysippus*? It would certainly seem to be the case in this Protectorate. The great rarity of the type form which I noticed before is by no means confined to Taveta, but seems universal on the Coast district, where the climatic conditions are anything but those of a desert area. I doubt if I have seen half-a-dozen of the type form in the last 2½ months, whereas the *klugii* form has been as common as usual.]

2. *Nymphaline Mimics*. *Hypolimnas misippus*, Linn., also abounds in British East Africa, but unlike the Danaïne model, the proportionate number of the two females (*inaria*, Cr., and the type form) shows no marked preponderance on either side.

There are also two species of *Euryphene*—*E. senegalensis*, Herr.-Sch., and *E. chriemhilda*, Staud., both occurring in the Coast hills, the females of which seem at first sight to come into the *chrysippus*-centred association. Both species frequent shady places and are generally common where found. Both male and female of both species settle on the ground and on plants with their wings spread out. They differ somewhat in their preferences, *E. senegalensis* being generally found in cultivated country—banana plantations and such like—whilst *E. chriemhilda* affects the real forest country and is more local. In both species the female greatly resembles *L. chrysippus*, but on the upper side

* Trans. Ent. Soc. Lond., 1902, p. 338.

† Journ. Bomb. Nat. Hist. Soc., 1892, p. 209.

‡ Researches on Mimicry, Part II, English Translation, Stuttgart, 1896.

only; while the male, which is destitute of the black and white tip, cannot be said to mimic this Danaïne. The habits of both *Euryphenes* are however markedly different from those of the other members of this combination. All these latter have a leisurely floating flight which increases the resemblance to the model. The *Euryphenes*, on the other hand, are characterised by a rapid skimming flight close to the ground, on which they are very fond of settling with their wings expanded. In such a position they are really very inconspicuous in the intense light and shade of the woodland and forest habitat which they prefer. They have moreover an under side which is evidently procrptic, and when sitting with closed wings they are exceedingly difficult to detect even when one has actually seen them come to rest. However, it is just possible that they may obtain some advantage from adopting a well-known aposematic appearance, and it is certainly difficult to account for the pattern of the female in any other way.

[Mombasa, Jan. 31, 1905.]

I must say I have doubts about the species of *Euryphene* which resemble *L. chrysippus* being mimics at all. There are two species of this group in the Rabai district, of which one is common and widely distributed in the district [*E. senegalensis*], whilst the other seems much more local [*E. chriemhilda*]. Both of these have [in the female] the colouring of the type form of *L. chrysippus*, but their habits are totally different. They are woodland insects, and have a rapid skimming flight about a foot from the ground, on which they are very fond of settling, though they also settle not unfrequently on low bushes. They almost invariably settle with their wings expanded, and frequently remain in this position for a considerable time. In fact, their habits and haunts are so totally different from those of *D. chrysippus* as to make it exceedingly unlikely that they are in any true sense mimics at all.]

3. *Acræine Mimics*. *Acræa encedon*, L., is quite common everywhere, and the form *daira*, mimicking *dorippus*, is certainly considerably more abundant than the typical *encedon*. The *fulvescens* form of *Acræa johnstoni* with other convergent *Acræas* belonging to the *dorippus*-centred combination has been already considered on pp. 514-517.

4. *Papilionine Mimics*. *Papilio dardanus*, sub-sp. *tibullus*,

♀ form *trophonius*, Westw. This form of the female is far less common than the *hippocoon* form, but it does occur at Rabai, etc., and, as is well known, bears a remarkable resemblance to the Danaine model. Its flight is stronger and generally more lofty, so that it can be recognised on the wing, but in all other respects it is a very good mimic. A new form of the female from Nairobi is described by Mr. Roland Trimen in the Appendix (p. 554) under the name *dorippoides*. As its name implies it is a mimic of the *dorippus* form.

5. *Moth Mimics*. The Geometrid (*Boarmiinae*) moth *Paraptychodes tenuis* should probably be associated with *D. chrysippus*, to which in general pattern it bears much resemblance. The moth is however, like the Euryphenes, a forest insect. I have taken it at Ndzovuni, near Rabai (July 21, 1906).

IV. *The Aletis-Euphaedra Combination in British East Africa.*

I have not as yet encountered many of the members of this powerful association so closely related to the *chrysippus*-centred combination and yet distinguished by distinct and conspicuous characters of its own. The probable central model in British East Africa is distinguished in the British Museum, as *Aletis ethelinda*, Kirby, from the well-known south-eastern species *A. libyssa*, Hopff. The only apparent difference is the deeper richer tint of the fulvous ground colour in the examples of the more northern form in the National Collection. My own specimens however taken at Rabai (a male on Oct. 13, a female on Oct. 30, 1906) do not differ in this respect from the southern *Aletis libyssa*; and it is exceedingly doubtful whether *A. ethelinda* can be maintained as a separate species.

The only other member of the combination I have seen is *Euphaedra cleus*, Drury, which I have once taken at Rabai in forest country.

B. ACRAEA-CENTRED MIMETIC COMBINATIONS.

These associations differ from those with Danaine models, because of the dominant place taken by synaposematic Acraeas themselves, and consequently the smaller proportion of mimics belonging to other groups.

a. *A Planema-Acræa-centred Combination.*

Both at Taveta and Rabai the form of *Planema aganice*, Hew., which has been named by Dr. Butler *Planema montana*, is common. This form is characterised by the rich fulvous colouring of the male, the female coming into the black and white combination centred round *Amauris niavius* f. *dominicanus*, as referred to on pp. 507, 508. Associated with this species, but perhaps always less numerous, I took a form of *Acræa esebria*, Hew., called by Miss Sharpe *Acræa jacksoni*, which bears a strong resemblance to it, especially on the wing, where the details of the black and fulvous colouring would not be prominent. This form is considerably smaller than *Planema aganice*, but they are so much alike that it was some time before I realised that they were not the same species.

[Rabai, July 1, 1908.

I once took a *Pseudathyma* (possibly a new species), now in the British Museum, which quite deceived me on the wing. I took it for *A. esebria* until I had it in the net.]

[Plymouth, Jan. 2, 1908.

I may also refer to the obvious resemblance of a male *Pseudacræa** to the males of these two *Acræines* [especially the rich fulvous-marked *Planema montana*], although I have not myself taken this mimic. The single specimen (from Shimba) in the collection I sent to Oxford, was given to me. This *Pseudacræa* from Shimba is probably the male of the form allied to *P. hirce*, mentioned on p. 508.]

1. *Further notes on Planema-Acræa Combinations.*

E. B. P.

My kind friend the author has presented to the Hope Department the following specimens of *Planema aganice* f. *montana* together with the *Acræas* resembling it:—

Dabida (May 25—June 16, 1904): 2 ♂ and 3 ♀ of *montana*, all normal except one female with a pale ochreous instead of a white patch on the hind-wing. There are no specimens of *A. esebria* from this locality.

* *Pseudacræa rogersi*, sp. nov. See Appendix, p. 549.

Taveta (May 8, 1905—Jan. 30, 1906): 7 ♂ and 4 ♀ of *montana*, 2 of the females with the pale markings of a cream tint instead of white: 6 *A. esebria*, of which 2 resemble the males of *montana* and possess fulvous markings, the others pale ochreous.

Kilimanjaro (Jan. 26–31, 1906): 1 ♀ *montana*: 1 ♀ *Acræa carmentis*. The latter is white-marked and resembles the much larger female of *montana*.

In looking through the fine collection of butterflies from the Congo State in the Brussels Museum I was surprised to find that the form *montana* was abundantly represented from this area.

In Mr. St. Aubyn Rogers' experience *Acræa esebria* is less abundant than the *Planema*, and the above figures support this conclusion. In Southern Africa, on the other hand, the *Acræa* appears to be much commoner than *P. aganice*. There is however a similar mimetic relationship,—and the same is true of the representative forms of *Acræa* and *Planema* on the West Coast. Everywhere the *Acræa* seems to exist with the *Planema* and to act as a variable and unstable mimic. The far greater constancy of the colours of the *Planema* leads to the inference that it is the model and the *Acræa* the mimic. Varieties of the latter commonly diverge and become rough but undoubted mimics of *Danais chrysippus*. There can be no doubt that the usual strong superficial resemblance between these two *Acræinæ*, combined with the divergence of *esebria* from the ordinary colouring and pattern of the genus *Acræa*, led to its erroneous inclusion for a time in *Planema*.

It is interesting to attempt to answer the question why *Planema aganice* acts as the model although it is, probably for the most part, a less abundant species. The reason is probably to be found in its greater constancy and also in its larger size. There are several other instances of mimetic associations between *Planema* and *Acræa*: in all that I am acquainted with the *Planema* is the larger insect and appears to act as the model. The dominance of a butterfly in the environment is affected by size as well as by numbers and other qualities: *ceteris paribus*, a large butterfly is likely to act as model for a small one. In a parallel instance from tropical America, the larger Nymphaline, *Colanis julia*, Fab., appears to act as model for the smaller Heliconine, *Euclides aliophera*, Godt., both

species swarming together over an immense range, and both probably equally distasteful. Evidence that *Colænis* is the model is yielded by a comparison of the northern and southern forms of both species. The northern *Eucides*, although diverging from the southern in the same manner as the *Colænis*, has not changed to so great a degree. In other words, the *Colænis* leads and the *Eucides* follows.

It is interesting to note that greater conspicuousness due to size may act in the same manner as greater conspicuousness due to pattern. *Amauris dominicanus* as contrasted with *A. echeria*, etc., seems to be an example of dominance due in large part to pattern. (See p. 432.)

These causes of predominant influence are of course relatively rare, the usual causes being greater unpalatability and superior numbers. Thus in nearly all the examples of mimicry figured in the four plates accompanying this memoir, the mimics are larger than their models, but the latter belong to the highly protected *Danainæ* and the genus *Mylothris*. The mimicry of the larger red and black *Acræas* by the immense *Papilio antimachus*, Dru., is a grand example of models far smaller than their mimic. There can be no doubt however that the models are here enormously more abundant and probably more distasteful than their gigantic mimic. In the case of *Planema-Acræa* and of *Colænis-Eucides* discussed above, there is not the same evidence for discriminating widely between the palatability and the relative abundance of the members of each pair. Their difference in size remains as an important distinction, and in both cases there is evidence that the larger species has acted as the model.

E. B. P.

b. *Red-and-black Combination centred by large Acræas.*

The commonest species in this group is *Acræa natalica*, Boisd., which is often very abundant, e. g. at Taveta. There are however several other *Acræas* which come into this group, though the distribution of the black spots on the red ground varies a good deal. These include *A. acara*, Hew., *A. anemosa*, Hew., *A. areca*, Mab., and *A. pharsalus*, Ward. Together with these must be associated the larger Nymphaline butterfly *Pseudocræa trimenii*, Butl., which is connected with the other species as regards pattern by *A. acara*, as regards size by *A. areca*.

Now although I have usually found *P. trimenii* a rare species, this is not the case at Rabai. In fact, in some seasons it is more common than any other member of the group with the single exception of *A. natalica*. It frequents much the same situations as the *Acræas* but its flight is more lofty and sustained, and when alarmed it goes off at a great rate. Still the integuments of the thorax are very tough and quite different from those of species which adopt a protective (cryptic) appearance. Although the specimens of *trimenii* from British East Africa differ in some details from the South African type, still they always have the brilliant pink and pearly white under side which at once distinguishes them from the nearly allied *P. boisduvali*, Doubl., in which the corresponding surface is ochreous.

[Taveta, July 5, 1905.]

Abantis tettensis, Hopff., mimicking on the under surface and at rest the pattern of the smallest *Acræas* of the *doubledayi* type, was quite common here in the rains in one place. It flies backwards and forwards with great rapidity quite in the usual skipper manner, and always settles with wings half-raised, so that it gives no idea of an *Acræa* on the wing or during the brief pauses between successive flights.]

1. *Further notes on Combination centred by large red-and-black Acræas.* E. B. P.

This group of large *Acræas* also includes *Acræa chilo*, Godm., captured by Rev. St. Aubyn Rogers in several localities. *A. astrigera*, Butl., not in his collection, but sent to me by Mr. and Mrs. S. L. Hinde from Fort Hall and Kitui, must also be regarded as a member, although apparently much rarer than any of the others. The group is furthermore perhaps united by its smallest members, *A. pharsalus* and small individuals of *A. natalica*, with the still smaller species,—*acrita*, Hewits., *bræsia*, Godm., *doubledayi*, Guér., and *neobule*, Doubl. The following table shows the numbers of specimens (with the inclusive dates) at Oxford captured by Mr. St. Aubyn Rogers at various localities in British East Africa.

LOCALITIES.	DATES.										
		<i>Acraea arita.</i>	<i>Acraea bresia.</i>	<i>Acraea nebulæ.</i>	<i>Acraea donbledayi.</i>	<i>Acraea natalica.</i>	<i>Acraea phœsalus.</i>	<i>Acraea areca.</i>	<i>Acraea anemosa.</i>	<i>Acraea chilo.</i>	<i>Acraea acara.</i>
The Coast district.	Mombasa	May 16—June 25, 1904.	...	...	...	...	...	1	...	...	1
	Rabai	April 1, 1905.	...	...	...	...	...	2	1	...	...
		May 28—Oct. 14, 1903.	...	...	1	1	...	1	...	...	1
		March 24, 1906—Jan. 21, 1907.	...	...	7	...	...	5	...	...	7
	Kalolein, Kaya Kauma, and Kowini	Feb. 21, 1903—Jan. 13, 1904.	...	5	...	1	...	...	...	6	...
		March 12, 13, 1906.	...	...	1	...	...	...	...	...	1
	Jilore, Mangea, Ndzovuni, and Meji (Giryama)	July 16—24, 1906.	...	...	...	1	...	4	1	...	2
	Mwaeba Hill and Shimba	Nov. 25, 1904.	...	...	...	...	...	...	...	...	1
		Oct. 4—Dec., 1906.	...	...	...	2	...	...	...	...	1
	Mazeras (Uganda Railway)	May 19, 1906.	...	...	...	...	...	...	1	...	...
	Mackinnon Road (Uganda Railway) and Maketao	April 10—June 13, 1905.	...	1	...	...	...	...	...	2	...
	Voi to Taveta	April, 1905.	...	6	...	...	...	...	...	1	...
	Taita Plain, Dabida and Sagalla Mountains	May 25—Jun. 21, 1904.	4	1	...	1	1	2	...	2	3
	Taita	May 26, 1905.	1	...	...	...	...	...	...	...	...
	Taveta	April 13, 1905—Jan. 26, 1906.	3	16	8	1	19	...	1	...	1
		May, 1905—Jan. 31, 1906.	1	1	...	1	...	1	4	...	...
	Kilimanjaro										
	Totals . . . . .	...	9	20	8	11	25	2	18	6	11

When the author was in England I asked him if he would kindly give me his general impressions of the relative abundance of the chief members of this important combination. At Rabai, *A. natalica* was the commonest, and then the following species arranged in the order of their abundance:—*Pseudacræa trimenii*, *Acraea acara*, *A. anemosa*, *A. areca*. At Taveta, on the other hand, where *natalica* swarms, the *Pseudacræa* was the rarest, and no definite impression remained of the relative numbers of the others. In the neighbourhood of Taita, *natalica* was the commonest species, and *areca* next, while the *Pseudacræa* was not seen.

It is important to bear in mind these impressions, founded on an experience going back to 1898, when studying the table printed above.

The relation of the eastern and western sub-species of *Pseudacræa boisduvali* to their respective Acræine models is interesting and peculiar. There can be no doubt that the eastern sub-species *trimenii* with its conspicuous sub-apical yellow-ochreous fore-wing bar, mimics *Acræa acara* (in which the apical portion of the fore-wing is warm red-dish-ochre), and bears no very close resemblance to *areca* or to any of the other large red black-marked eastern Acræas. The western *boisduvali*, on the other hand, is a much closer mimic of *Acræa egina*, the western representative of *areca*, than it is of *zetes*, the representative of the eastern model of *trimenii*. This is all the more remarkable because *zetes* is replaced by *acara* in the Cameroons, as I was astonished to find in the collection of the Brussels Museum.

This mimetic relationship is unusual, and is all the more remarkable because the eastern mimic is transitional into the western, the eastern model into the western *zetes*, the western model into the eastern *egina*. It is probable that this curious relationship is to be explained by the fact that *acara* is, on the whole, predominant over *areca* in the range of *trimenii*, and *egina* (the W. representative of *areca*) predominant over *zetes* (the W. representative of *acara*) in the range of *boisduvali*. (Compare Mr. Roland Trimen's account on pp. 552-554.*)

A very interesting detail in the mimetic resemblance of the *Pseudacræa* is to be seen in the palpi, which are orange like those of *Acræa acara*, *A. areca*, *A. anemosa*, and *A. natalica*. A parallel case is to be found in the *Methona-Thyridia*-centred combination of tropical South America, in which the yellow or orange-clubbed antennæ of the models are mimicked by *Danaïnx* (*Ituna*), *Pierinæ* (*Dismorphia*) and Castniid moths. In both cases the small size of the mimetic feature is probably compensated by its prominence.

E. B. P.

c. *Combination of small fulvous and black Acræas from Weithaga.*

This group consists entirely of species of the genus

* Just as Mr. Trimen finds obvious links with the western *boisduvali* in the pattern of certain eastern individuals, and especially one of the Rabai specimens here referred to, so also a clear transition towards the eastern *trimenii* may be seen in Angolan specimens in which a trace of the ochreous sub-apical fore-wing bar is present. It is however probable that *acara* and not *zetes* is the Angolan form.

Acræa, i.e. *A. cabira*, Hopff.; *A. vinidia*, Hew.; *A. alicia*, E. M. Sharpe, and *A. terpsichore*, L. (*serena*, Fabr.), the latter being an outlying member.

In Northern Kikuyu it is the local species *A. alicia*, which is dominant in numbers. This species is by far the most abundant butterfly in the whole country, and I once counted 460 specimens which had settled for the night on one small tree. *A. alicia* flits restlessly round bushes and small trees, quite after the manner of some of the blues. They settle occasionally on the trees or on low herbage. The males are much the commoner. Although so different on the under side, I could not distinguish the males and females on the wing. The female of *A. alicia* is dimorphic on the under side, and the two forms bear a considerable resemblance on this surface to *A. cabira*, Hopff., and *A. vinidia*, Hew. (f. *tenella*, Rogenh.) respectively.

The captures of members of this group are recorded in the table prepared by Professor Poulton, on p. 530.

1. *Description of two mimetic forms of the female of Acræa alicia*, E. M. Sharpe. E. B. P.

Acræa alicia, E. M. Sharpe, new female form, *cabiroides*.

The distinguishing features of this form are confined to the under surface, which is alone referred to in the following account. The under surface of the hind-wing and of the apical region of the fore-, bears a strong superficial likeness to the same parts of the larger butterfly, *Acræa cabira*, Hopff. The broad bar crossing the centre of the hind-wing and to a less extent the sub-apical bar of the fore-wing tend to become very pale, often attaining a cream tint like that of the same markings in *cabira*. The wide and complex marginal markings much resemble those of *cabira*, the internal contour of the marginal band is a pronounced bay near the apical angle of the hind-wing, being strikingly similar. The sub-basal band of black spots of the hind-wing is strongly developed and often presents the appearance of an irregular double row, although the dark red colour which is conspicuous between the two rows of *cabira* is almost wanting. Within these spots the base of the hind-wing is of a greyish tint, as in *cabira*.

The features which distinguish *cabiroides* are thus con-

WEITHAGA.	<i>Acrava terpsichore (serena).</i>	<i>Acrava cabira.</i>	<i>Acrava vinidia.</i>	<i>Acrava alicia.</i>
1906.				
Aug. 9 . .	...	...	...	3 ♂ 2 W 3 ♀ c. } all W 2 ♀ t. } 1 ♀ i. } 1 ♀ c. W -
Aug. 11 . .	...	...	...
Aug. 13 . .	...	1 ♂ W 2 ♀ W	3 ♂ 1 W + 2 W	...
Aug. 15 . .	...	1 ♂ W	...	...
Aug. 17 . .	...	6 ♂ 5 W	...	...
Aug. 22 . .	...	2 ♂ W	5 ♂ 1 ♀ 1 W + W + 2 W 2 W -	1 ♂ 1 ♀ c. W -
1907.				
Feb. 19 . .	...	...	...	1 ♀ c. W -
March 7 . .	...	...	...	2 ♂ 1 ♀ c. W -
March 8 . .	...	...	...	1 ♂ W
March 12 . .	1 ♂	...	...	1 ♀ c. 1 ♀ t.
March 14 . .	...	...	1 ♀ W +	♂ in cop. with ♀ t. W
March 20 . .	...	...	...	♂ in cop. with ♀ c.
March 23 . .	...	...	2 ♂	...
March 25 . .	...	...	1 ♀	...
March 27 . .	...	1 ♀	2 ♂ 1 W -	...
March 28 . .	...	...	...	1 ♀ c. W -
April 16 . .	1 ♀	...	...	...
April 17 . .	...	...	1 ♀ W	...
Totals . .	1 ♂ 1 ♀	10 ♂ 3 ♀	12 ♂ 4 ♀	9 ♂ 15 ♀

c = *cabiroides* ♀ form of *alicia* mimetic of *cabira* on under side.

t = *tencelloides* ♀ form of *alicia* mimetic form of the *tencella* form of *vinidia* on under side.

i = ♀ form of *alicia* intermediate between the above.

W + = wings considerably worn (not chipped or notched except very rarely).

W = moderately worn.

W - = little worn.

Specimens without W are fresh.

fined to the parts of the under surface which are visible at rest: they probably sub-serve Müllerian mimicry during repose. There can be no doubt that the resemblances in question are based on affinity: comparison between the *cabiroides* female form and *bonasia*, F., the western representative of *alicia*, makes this evident. But, at the same time, it is equally clear that in the presence of the British East African *cabira*, just those elements in the pattern have been retained, developed and modified, which would thereby promote resemblance during repose.

TYPE captured, March 28, 1907, at Weithaga, N. Kikuyu, British East Africa; in Hope Department, Oxford University Museum.

The *cabiroides* form was taken *in coitu* with the male *A. alicia* on March 20, 1907.

Acrava alicia, E. M. Sharpe, new female form *tenelloides*.

Distinguishing features are confined to the under surface which is alone referred to below. The under surface of this female form, which is apparently less abundant than *cabiroides*, superficially resembles that of the *tenella*, Rogenh. (= *abbotti*, Holland), form of *Acrava vinidia*, Hew., found abundantly in the same locality (Weithaga). As in *cabiroides*, the resemblance is confined to the parts of the under surface that are visible during repose. The sharp demarcation between the marginal markings and the paler ground colour is obscured by an over-spreading ochreous shade, producing an effect entirely different from that of the *cabiroides* form and its model, but somewhat similar to *tenella*, especially the females. The cream-coloured band crossing the hind-wing which is so conspicuous a feature in the *cabiroides* form, is here obsolete or invisible, being of a pale yellow tint like the rest of the disc. The marginal pattern is much reduced, the inner part with its bay, which is so characteristic a feature in *cabiroides*, being absent or only to be made out by careful examination. Thus reduced, the margin is only about half the width attained in the other mimetic female form, being of about the same proportion as in *tenella*, and like it with an internal contour nearly parallel with the hind margin of the wings, and with a bay which is slightly marked as compared with that of *cabira* and its mimic. The triangular yellow internervular markings which invade the border from the hind margin of the hind-wing resemble the similar orange

marks of *tenella*,—especially the female of this latter, in which the triangles are less prominent and less sharply defined. In *cabira* and in the most fully-developed *cabiroides*, these markings are of a cream tint and very conspicuous. In all characters hitherto mentioned except the overspreading ochreous shade the *tenelloides* form tends to assume the pattern of its own male, and it might be held that this and not the mimicry of *tenella* is the significance of the difference between the two female forms of *alicia*.

The pattern of the male is however extraordinarily sharp and conspicuous, while that of *tenelloides* is obscured and ill-defined, so that the two patterns, however similar they may prove to be on close examination, have an entirely different superficial appearance. Furthermore, the remaining important characters towards the base of the hind-wing diverge from the pattern of the male *alicia* and resemble those of *tenella*. The sub-basal black spots retain the appearance of a double row as in *cabiroides*, but are much reduced in size, while individual spots are lost, especially in the central or intra-cellular part of the series. The male, on the other hand, possesses an irregular single row of very heavily marked black spots, as well developed in the cell of the hind-wing as elsewhere. The points in which the band of *tenelloides* differs from that of its own male and from the other female form, bring about an approach towards the pattern of *tenella*, which can hardly be accidental. In both sexes of *tenella* there is an irregular double sub-basal row of small spots, of which the largest are a pair (one spot for each row) within the costal margin, while the most numerous form a group within the inner margin. Between these two extremities the rows are only represented by two spots in the cell, of which the outer is usually the more conspicuous and sometimes the only constituent. In the *tenelloides* form we also find the two prominent costal spots, the numerous small spots at the other end of the series, and the median reduction to one or two spots in the cell.

Tenella furthermore differs from *cabira* in the absence of a well-marked bluish-grey basal area within the sub-basal spots, a feature that is mimicked in the best developed *cabiroides* females and suppressed in the best developed *tenelloides*, where the area in question is, as in the model, rather darker than the rest of the under surface, but differs

from the model in the absence of basal orange marks, somewhat conspicuous against the yellow ground colour. *Tenelloides* appears to display more evidence of special adaptation and a smaller use of ancestral features in the attainment of a mimetic appearance, than *cabiroides*.

TYPE captured, March 12, 1907, at Weithaga, N. Kikuyu, British East Africa; in Hope Department, Oxford University Museum.

The *tenelloides* form was taken *in coitu* with the male of *A. alicia* on March 14, 1907.

These two female forms are probably specially developed in N. Kikuyu in relation to the abundance of *cabira* and *tenella*. I have not found the same sharp differentiation into two contrasted forms in the females from other localities which I have had the opportunity of studying. Very great variation in the under surface pattern of the females was however always evident; and even at Weithaga intermediate forms appear, while distinct traces of the *cabiroides* pattern, invisible at a little distance, can be made out on a careful examination of some of the *tenelloides* females.

E. B. P.

2. *The peculiar aposematic pattern of the under surface in the male Acræa alicia.* E. B. P.

The visible under surface of the male of this species and the allied *A. urui*, Grose-Smith, possesses a remarkable and characteristic pattern. The ground colour and apical bar of the fore-wing are bright yellow, the sub-apical bar of the fore-wing and the border of both wings deep black, the border containing prominent yellow markings, developed along the hind margins of both wings. The sub-basal row of black spots of the hind-wing is so strongly developed as nearly to form a continuous band, within which the ground colour assumes a greenish tint. The effect of the simple pattern thus briefly described is very peculiar and unlike that of other *Acræas*. E. B. P.

3. *The synaposematic upper surface pattern of Acræa alicia, urui, etc.* E. B. P.

Although the females are so different from the males on the under surface, that of *urui* resembling the *fulvescens* form of *Acræa johnstoni* (see p. 516), the pattern of the upper surface is very similar in the two sexes. The females of

alicia and *uvui* are indeed distinguished from the males by the pale markings in the black hind marginal border, but in spite of this are indistinguishable upon the wing (see p. 529). Mr. S. A. Neave, M.A., B.Sc., has called attention to this upper surface aposematic pattern and has pointed out that *Acrea vinidia* (*tenella*) possesses a very similar upper surface (Trans. Ent. Soc. Lond., 1906, p. 219). E. B. P.

d. *Pardopsis punctatissima*, Boisd., as a model.

P. punctatissima is a very common widespread species in East Africa and there is generally associated with it a Lycænid, *Pentila amenaida*, Hew., and in other localities other species of the same genus. Both are woodland species, though the Lycænid prefers much more shady places than *P. punctatissima*. The latter is altogether duller in colouring and its flight is much nearer the ground.

When at Taveta I was much struck by the resemblance of a diurnal Geometrid moth, *Petovia dichroaria*, Herr.-Sch., which I took flying with *P. amenaida*, on December 9, 1905. The resemblance does not appear very strong in the cabinet, but on the wing the similarity of their flight and their general appearance is very deceptive, so much so that I have had difficulty in discriminating between the species in the living state. The moth is somewhat brighter in colouring than the Lycænid. *P. punctatissima* is commoner at Rabai than at Taveta, and *P. amenaida* is also abundant, but I do not remember seeing the moth.

P. amenaida gives one the idea of being itself protected. It is very fond of settling in little companies on low plants, and if disturbed often opens its wings a few times without quitting the surface on which it is resting. Its flight is very feeble indeed.

[Rabai, August 29, 1908.]

I have lately taken *Pentila amenaida* and *Pardopsis punctatissima* together. Many specimens of the *Pentila* are smaller with the spots fewer and smaller, so as to bear little resemblance to the *Acrea*. Although the *Pentilas* are more addicted to forest country and the *Pardopsis* to grass-lands with patches of bush, they may be seen flying together. The *Pentila* is even commoner than the *Pardopsis*.]

1. *Further notes on the mimics of Pardopsis.* E. B. P.

It is probable that the Geometrid moth is a secondary Müllerian mimic of this specially protected Lycænid. Mr. Guy A. K. Marshall captured the same species at Malvern, Natal, flying with another distasteful Acræiform Lycænid—*Alæna amazoula*,* Boisd. Four examples of the moth and three of the *Alæna* taken by Mr. Marshall, September 26, 1897, are now in the bionomic collection of the Hope Department. These specimens of the moth are much paler in tint, and possess far darker veins than the individuals from Taveta, of which a second was taken by Rev. St. Aubyn Rogers on December 26, 1905. These local differences in the moth correspond to obvious points of distinction between the *Alæna* and the *Pentila*, thus suggesting the conclusion that the two *Lycænidæ* act as models. A much larger number of specimens from both localities must however be examined and compared before this conclusion can be regarded as established.

There is no doubt that both these Lycænids are mimics of the *Acrwinæ*—the *Pentila* of *Pardopsis*, the *Alæna* of a general type of Acræine colouring—thus supporting the opinion that the resemblance of the moth is a case of secondary mimicry. I found that both *Alæna amazoula* and *Pentila amenaida* had been placed among the Acræas of the Hope Department by the late Professor Westwood. Unnamed and evidently unstudied they had been placed where almost any naturalist unfamiliar with their section of the *Lycænidæ* would have placed them if he had not the time to make a careful examination. E. B. P.

C. MIMETIC COMBINATIONS AMONG THE PIERINÆ.

I. *Mylothris-centred Combinations.*a. *Mylothris agathina-centred Combination taken at Rabai.*

The following specimens were captured at Rabai, June 23, 1906:—

Myl. agathina, Cram., ♂. See Plate XXIX, fig. 5, for under surface.

Belenois thyrsa, Hopff., ♀: dry f. See Plate XXIX, fig. 6, for under surface.

* Trans. Ent. Soc. Lond., 1902, pp. 497, 498.

Leuceronia argia, Fabr., ♀: dry f. See Plate XXIX, fig. 7, for under surface.

All the specimens were in good condition except the *Mylothris*, which was slightly worn. These species are all fairly common at Rabai and are found frequenting the same stations. *M. agathina* is, perhaps, more distinctively addicted to the open country, but all are found in woodlands, and *M. agathina* and *B. thysa* may frequently be seen flying together.

In this district the commonest species is *B. thysa*, though the association is probably grouped round *M. agathina*, which has the slow leisurely flight of a protected species.

B. thysa has a much more rapid flight when disturbed, but, like most of the members of its genus, it is frequently seen settled on flowers, and it is comparatively rare to find specimens which show evidence of the attacks of birds.

L. argia is more of a forest insect, and the flight of the males is high and strong. The female usually flies much lower and much less strongly than the male, so that it approaches the other two members of the combination in habits as well as in colouring.

[The mimetic resemblance, which is developed upon the under surface of the wings, is represented on Plate XXIX, figs. 5-7. The orange flush at the base of the fore-wings which is the distinctive feature of the male *Mylothris* and the females of the other two species, is distinctly shown in the plate. The mimetic likeness attained by the female *Leuceronia* (Fig. 7) is seen to be very rough as compared with that of the *Belenois* (Fig. 6). Furthermore, the orange flush of the *Leuceronia* resembles that of the *Belenois*, and more closely that of the *Mylothris*,—probably due to secondary mimicry; but many specimens must be compared before this suggestion can be accepted. It is of much interest to note that the primary model resembled by these two females is a male, the orange flush of the female *Mylothris agathina* being obscured by the general brownish-orange colour of the wings. E. B. P.]

b. *Mylothris agathina*-centred Combination from Kilimanjaro.

Myl. agathina, Cram., 1 ♀ (worn, a large notch in left fore-wing), Jan. 26-31, 1906.

Myl. poppæa, Cram., 1 ♀, Jan. 26-31, 1906.

Myl. yulei, Butl., 4 ♀, Jan 5-16, 1906.

Myl. rüppellii, Koch, 1 ♀, Jan. 5-16, 1906.

Pinacopteryx rubrobasalis, Say, 3 ♀, Jan. 5-16; one, Jan. 26-31; two, 1906.

With regard to the upper surface *M. poppæa* is much brighter orange than the others. The other species of *Mylothris* resemble one another and are approached by the palest of the three specimens of the *Pinacopteryx*.

On the under side the palest *Pinacopteryx* beautifully mimics the *M. rüppellii*, while the other two specimens of the *Pinacopteryx* mimic *M. agathina*, in which the ground colour of the hind-wing is ochreous. The *M. yulei* and *M. poppæa* resemble each other closely.

The predominance of the genus *Mylothris* in this combination is very evident, and there is no doubt that it is distasteful to some enemies, at any rate. All the specimens were captured for me by natives, as I was unable to go to Kilimanjaro at that time. When I was on the mountain in September I observed the abundance of this combination and obtained specimens of some of its members.

c. *Mylothris*-centred Combination from Weithaga.

The table on p. 538 represents all the specimens of an interesting Pierine combination captured at Weithaga in the Northern Kikuyu country, a part of the Kenia province of the colony.

The most dominant species is *Mylothris rubricosta*, Mab., which is found almost exclusively in swampy places, and is also very abundant. *M. rüppellii*, Koch, is also found commonly, but I do not remember having ever seen *M. agathina* in this part of the Kikuyu country.

Associated with these is found *Phrissura phæbe*, Butl., of which the under surface of the female bears most resemblance to *M. agathina* ♂, whilst that of the male is nearer to both sexes but especially the male of *M. rubricosta*. On the upper side the female of *P. phæbe* is,

WEITHAGA.	<i>Mylothris rubricostata.</i>		<i>Mylothris rüppellii.</i>		<i>Phrissura phæbe.</i>	<i>Pinacopteryx pigea</i> , N. form of.	
1906.							
Aug. 15 .	3 ♂	5 ♀	...		...	...
Aug. 16 .	8 ♂	2 ♀	...		...	...
	Anal angles of both H.W.s notched in 1 ♀.						
Aug. 18 .	...		2 ♂		...	...
			Left wings of both cleanly shorn.				
Aug. 22 .	...		...		1 ♂ Chipped.	1 ♂ Chipped, and specially at anal angle H.W.	
Aug. 23 .	1 ♂		1 ♂		...	...
			Left H.W. shorn.				
Aug. 24 .	...		1 ♀		...	...
			Worn, rather chipped.				
1907.							
Feb. 13 .	...		...		...	1 ♂	
March 9 .	2 ♂		...		...	...
March 13 .	1 ♂		...		...	...
March 19 .	...		...		...	1 ♂	
						Rather worn.	
March 23 .	...		...		...	1 ♂	1 ♀
						(normal)	
April 5 .	...		...		...	1 ♂	
April 13 .	1 ♂		...		1 ♀	...	
April 20 .	...		...		...	...	1 ♀
						(mimetic)	
May 11 .	2 ♂	1 ♀	...		...	Fresh, chipped.	
	Anal angle of one H.W. notched.						
May 13 .	1 ♂		...		...	...
Totals .	19 ♂	8 ♀	3 ♂	1 ♀	1 ♂	1 ♀	5 ♂ 2 ♀

however, much nearer to the two species of *Mylothris* captured with it, but especially to *M. rüppellii*, because of the development of the black markings.

The most interesting species of the combination, however, is the single female of the northern form of *Pinacopteryx pigea*, Bois., captured April 20, which is quite different from the normal form and distinctly mimetic of the section of the genus *Mylothris* of which *M. agathina* ♂ is the best-known example. On the under side the

resemblance is strongest to the male of this species; but on the upper the likeness to the two species of *Mylothris* actually taken with it, and especially *M. rubricosta*, is more evident. This remarkable female of *P. pigca* chiefly resembles the female of *M. rubricosta* in the indistinctness of the orange-red flush, whilst the slight black margin brings it nearer to the male of the same species.

This form of the northern *P. pigca* has not been taken hitherto, and is, in Dr. Dixey's opinion, perhaps transitional towards *P. rubrobasalis*, Lanz.

It would be of considerable interest to ascertain whether this mimetic female is a seasonal form, and whether it is to be compared with the special development of mimicry in the dry season phase of *Belenois thysa*, as described by Dr. F. A. Dixey.* The seasons are not however well marked in Northern Kikuyu, and the country never reaches the parched state which seems necessary for the full development of the dry season phase of most *Pierinæ*.

It will be observed from the table on p. 538 that several specimens show injuries probably caused by the attacks of birds, and that this evidence is stronger in the case of *M. rüppellii*, although a model, than in that of the mimetic species. The cleanly shorn hind-wings of more than one specimen of *M. rüppellii* especially afford very strong evidence of attacks by such a weapon as the beak of a bird.

The great predominance of Pierine mimicry within and convergent towards *Mylothris* is well seen in the tabulated Weithaga specimens; for the only other Pierines captured at the same period in this locality were:—

- 1 *Belenois mesentina*, Cram.
- 6 *Synchlōe johnstoni*, Crowley.
- 2 *Terias brigitta*, Cram.
- 3 *Terias regularis*, Butl.
- 2 *Terias senegalensis*, Boisd.
- 3 *Colias electra*, Linn.

II. *Belenois-centred Combination from Taveta.*

Dr. Dixey has brought forward much evidence to show that *Belenois thysa* is a protected species, and, to judge from their abundance, it would seem that *Belenois severina*,

* Proc. Ent. Soc. Lond., 1906, pp. xxxvi, xxxvii.

Cram., and *B. mesentina*, Cram., should be regarded in the same light.

Whilst at Taveta it seemed to me that these two species formed a centre of convergence for other *Pierinae*. On May 10, 1905, the following were captured:—

B. severina, Cram., ♀.

Teracolus halimede, Klug, ♀.

Teracolus celimene, Lucas, ♀.

Abantis levubu, Wallgr., ♂.

All these species bear a considerable resemblance on the wing, and all settle in exactly the same way with wings half raised. I think *Teracolus castalis*, Staud., might be added to the assemblage. The convergence is greatest between the ♀ *T. celimene* and the ♀ *B. severina*, and I have little doubt that the *Belenois* has acted as a model in this case. The other two species are more like the males of *B. severina* and *B. mesentina*; and though in mounted specimens it may not seem very evident in the case of the *Teracolus* still it is very appreciable in nature. The Hesperid is of great interest, as mimicry in this group is so rare. The species has a rapid flight as is usual in this family, but its comparatively large size and its conspicuous black and white colouring mark it out at once from its congeners and give it a strong superficial resemblance to the forms mentioned above.

Teracolus has a habit of congregating in special places to roost every evening, generally several species being present at one and the same place, with the two common species of *Belenois*. These places are generally exposed to the rays of the sun as it sinks in the western horizon, and the same situations are used for months and even years.

[Rabai, Aug. 29, 1908.]

As the rest attitudes of all butterflies are of some importance, you may be interested to hear that I twice saw *Belenois thyra* in the position of permanent rest. In one case a single shattered specimen was observed resting on the under side of the leaf of a small tree where it was well concealed, but two other specimens (quite fresh) were seen resting on the upper side of the leaves of a small bush in the forest with bright green leaves, against which the yellow under side was most conspicuous and could be

visible from some distance. At this time of the year very few butterflies are on the wing before 7 o'clock, whilst the early morning hours are a time of great activity for birds.]

[Rabai, Aug. 29, 1908.]

Some of the smaller *Acræas* are anything but conspicuous on the under side,—even *A. encedon* which is so abundant and widely distributed. It is no doubt an advantage to them to be fairly well concealed in the position of complete rest.]

1. *Resemblance between a female Teracolus vesta and a female Belenois severina taken together at Taveta.*

E. B. P.

When looking over the *Pierinæ* captured by the author at Taveta, I noticed a female specimen of *Teracolus vesta*, Reiche (represented on Pl. XXIX, fig. 9), which strongly suggested the facies of the female of *Belenois severina*. When I turned to the series of this latter species, it was at once seen that on the very day (April 25, 1905) on which he had captured the *Teracolus*, a female *severina* closely resembling it had also been taken. The specimen is figured on Pl. XXIX, fig. 8. The pale salmon tint which usually appears on *T. vesta* is wanting from the upper surface of this specimen, of which the ground colour is a very pale greenish-yellow like that of the *Belenois*. The oblique black marking which starts from the costa of the fore-wing and crosses the end of the cell is strongly developed in the *severina*, closely resembling the *Teracolus*, in which it is a characteristic feature of the upper surface. Beneath, the yellow and orange tints and dark markings are very different in detail, but their general effect is the same. On the wing and at rest from a little distance, the butterflies would be indistinguishable. E. B. P.

D. NOTES ON THE SEASONAL FORMS, ETC., OF PRECIS IN
BRITISH EAST AFRICA.

[This section is chiefly made up of quotations from letters by Rev. K. St. Aubyn Rogers, and noted on the specimens presented by him to the Hope Department.

E. B. P.]

a. Precis sesamus, Trim.

Rabai, Sept. 30, 1906.

I should have mentioned that I found *Precis sesamus* in Kikuyu (I had a month there during August 1906). All the specimens I took were the dry form, which is what one would expect; but I saw the wet form once. This year has been very wet in Kikuyu as well as at the coast, but the rains stopped in Kikuyu early in June, and I was there in the Dry Season: still the country was not at all dried up and the grass was still green. I doubt if it does dry up at this time of year in normal years. I also found *Precis archesia*, but those were all of the "wet" phase, which is rather extraordinary.

Plymouth, Jan. 3, 1907.

I do not think I have ever sent you the list of captures of *Precis sesamus* in North Kikuyu [Weithaga]. I have no record of those taken in Aug. 1906 [see preceding letter], but those of 1907 are as follows:—

1907.	DRY-SEASON FORMS.	WET-SEASON FORMS.
Feb. 16	1	3
Feb. 19 . . . . .	...	1
Feb. 22	1	1
Feb. 26 . . . . .	...	1
March 4 . . . . .	...	2
March 5 . . . . .	...	1
March 11	1	...
March 19 . . . . .	...	2
March 23 . . . . .	...	2
April 2 . . . . .	...	1
April 5	1	1
April 6	1	...
April 8 . . . . .	...	1
April 12 . . . . .	...	1
April 19 . . . . .	...	1
April 20 . . . . .	...	3
April 22 . . . . .	...	1

[The following list of Rev. St. Aubyn Rogers' captures at Weithaga differs in a few details from that given by him. The dates recorded below were copied from the "papers" in which the specimens were enclosed.

WEITHAGA.	DRY-SEASON FORMS.	WET-SEASON FORMS.	REMARKS.
1906.			
Aug. 9. . .	1 C	...	...
Aug. 15. . .	1 W C	...	...
1907.			
Feb. 16. . .	1	2 1 W -	...
Feb. 18. . .	...	1 W + C +	...
Feb. 22. . .	1	1	The right hind-wing of dry form cleanly shorn as if by bird's beak.
Feb. 25. . .	...	1 W + C +	...
March 4. . .	...	1 W + C	...
March 5. . .	...	1 W	...
March 19. . .	...	2, 1 W + C +	The worn specimen is transitional towards the dry form: the other a fine fresh specimen.
March 23. . .	...	2 W + C +	...
April 2. . .	...	1	A very fine fresh specimen.
April 5. . .	1 W C +	1 W - C -	Both hind-wings of dry form shorn cleanly and symmetrically as if by a bird.
April 6. . .	1 C +	...	...
April 8. . .	...	1	...
April 12. . .	...	1 W C -	...
April 19. . .	...	1 W + C +	...
April 20. . .	...	2, 1 W -	...
April 22. . .	...	1 W + C + 1	...

The indirect evidence of injury inflicted on fresh or not greatly worn dry-season forms by birds, when the wet individuals so often exhibited strongly marked indications of ordinary wear and tear, may throw light on the bionomic value of the pattern of the phase to which the latter belonged.

E. B. P.]

Rabai, July 1, 1908.

I have been up country again and have one more small contribution towards the elucidation of our old friend, *Precis sesamius*. I was at the Mukaa Hills, about 30 miles E. of Machakos, in the second week in June. You will perhaps remember that Hinde took about equal proportions of the two forms a little earlier than this at Machakos in 1900. The present season has been marked by deficient rainfall, and the heavy rains did not begin till April 20, which was very late.

The rainfall at Machakos for the first five months of 1900 and 1908 is quoted below, extracted from the Meteorolog. Records of the Agricult. Dep., B. E. A.:—

	1900.	1908.
Jan.	8·17 in.	0·80 in.
Feb.	8·10 in.	0·74 in.
March	10·15 in.	1·45 in.
April	5·43 in.	5·35 in.
May	5·89 in.	2·81 in.

The result of this late commencement in the present year is well seen in the series I have taken. *P. sesamus* was very common, but I only saw *one* dry form, which I took—a very fresh specimen. All the remainder, in all stages of freshness, were *Wet*, though one is a little intermediate. I think this is very remarkable, and may have some bearing on the stimulus. I should say that Mukaa is a dry place, and very open with little bush even. I searched the lower valleys and in the very sparse woods, but the single specimen was the only one I saw.

[The specimens obtained by Mr. and Mrs. S. L. Hinde are quoted below from Trans. Ent. Soc. Lond., 1902, p. 447, etc.

Machakos Road, May 22, 1900.—Twelve *P. sesamus*,—6 wet, mostly worn; 6 dry and fresh.

Machakos, June 6, 1900.—Six *P. sesamus*,—2 wet; 1 on the wet side of intermediate; 3 dry. All were fresh except one of the wet forms.

The comparison with Rev. St. Aubyn Rogers' captures is very striking, and the specimens collected by the same naturalist on Kilimanjaro in the autumn of 1905 should also be compared. See Proc. Ent. Soc. Lond., 1906, pp. lviii, lix, where the capture of many dry forms and a single wet is recorded. The latter, a fresh male, was taken Sept. 22, *in coitu* with a slightly worn and much torn dry female. The dry forms were mostly worn.

E. B. P.]

b. *Precis antilope*.

Rabai, 1906.

I spent a day or two in Taita on my way down, but the weather was not good, and I got nothing except on the march in to Voi, when I captured, among other things, the wet-season phase of *Precis antilope*,—the only example

I have seen * and one which may throw some light on the causes of the seasonal change.

The season should normally have been in the very height of the shorter dry season. But the seasons there are somewhat uncertain. Normally the smaller wet season is almost confined to November in Taita; after which comes the hottest and driest part of the whole year when insect life is at a minimum. The greater rains normally come about the middle of March or later. This year [1906] the rainfall in the latter rains was heavier than usual and lasted till much later. Moreover, there was heavy rain (5 inches or more) during the first week in February and I got the wet phase of *P. antilope* on the twelfth.

The falls are very local in these latter rains, and some places in Taita have suffered from a great deficiency of water, even this year, whilst in Taveta 50 miles away we hardly had any rain at all.

c. Precis archesia, wet-season form *pelasgis*. E. B. P.

The collection of this interesting and puzzling species from Weithaga was made during the following months:— 1906, August (7 specimens); 1907, February (2 specimens); March (4 specimens); April (4 specimens); May (1 specimen). It is not necessary to record the precise dates; for the whole of these, together with 7 Weithaga specimens, bred Feb.–April 1907, are of the wet form *pelasgis*, although falling short to a varying extent from the full wet forms of southern Africa.

Five eggs laid, Feb. 24, 1907, by a female on the wild food-plant were collected, although the parent unfortunately escaped. It was however a typical British East African wet-season female. The following table shows the very uniform length of the stages in the 5 individuals:—

EGG LAID.	HATCHED.	PUPATED	EMERGED.
1907.	1907.	1907.	1907.
Feb. 24	March 5	April 1	April 16
Feb. 24	March 5	April 1	April 16
Feb. 24	March 5	April 1	April 17
Feb. 24	March 5	April 2	April 18
Feb. 24	March 5	April 2	April 18

* The Hope collection contains a wet phase *antilope* captured by the author at Taita on May 26, 1905.

Two ova, of unknown parentage, were also found on the food plant. The larvæ which hatched from them pupated on April 5, an imago emerging on April 20, the other on the 21st.

These 7 bred specimens appear on the whole to show the *pelasgis* (wet) characteristics rather less fully than the majority of the captured specimens. This is especially true of the last-mentioned specimen, which emerged on April 21st. A comparison with the captured specimens renders it probable that these very slight differences are merely the result of artificial conditions, and do not indicate any tendency towards the development of the dry phase during April.

The chief character in which these more northern *pelasgis* approach *archesia* and fall short of the development attained by the wet-season forms in southern Africa is the usual grey-mottled appearance of the dark ground colour on the under surface, especially noticeable in the basal halves of both wings. In southern specimens, on the other hand, this dark ground colour is uniform and patternless. In other less striking features the northern forms appear also to approach *archesia*, but an account of them is postponed until a long series of southern specimens has been carefully examined from this point of view. In the meantime there is no doubt about the general existence of the important difference described above, and it is probable that the appearance of intermediate characters in the northern *pelasgis* may throw light on the evolution of the most completely specialised and contrasted seasonal forms of the species.

E. B. P.

d. *Habits of Precis natalica and P. elgiva.*

Rabai, Sept. 30th, 1906.

I see [in Trans. Ent. Soc. Lond., 1902, p. 423] that in S. Africa *Precis natalica* and *P. elgiva* are both described as forest butterflies. This is not the case here. *P. natalica* is common at Mombasa even in parts of the island where there is no wood at all, and the scrub is not more than 8 ft. or 10 ft. high, and I found *P. elgiva* in N. Kikuyu where woods of any size are few and far between, and there is nothing that could be called forest anywhere near.

APPENDIX.

Description of new forms of British East African butterflies in the Hope Department, Oxford University Museum, chiefly collected by the Rev. K. St. Aubyn Rogers, M.A., F.E.S. By ROLAND TRIMEN, Hon. M.A. Oxon., F.R.S., F.E.S., &c.

Family NYMPHALIDÆ.

Sub-family ACRÆINÆ.

Acræa asboloplintha, Karsch,* *sub-sp. nov., rubescens.*

Exp. al. (4 ♂) 2" 1—2"; (1 ♀) 2" 1".

♂. *Fore-wing*: fuscous ground of a clearer, less brownish but more ashy, tint than in typical form; black spots larger and more distinct; inner-marginal rufous, usually present in *asboloplintha* as a more or less obscure stripe from before middle to near posterior angle, is extended upward so as to form a median band, variable in development, and ill-defined on its edges, but intruding on discoidal cell and more or less filling space between sub-basal and medio-discal black spots. *Hind-wing*: deeper and brighter rufous; all medio-discal black spots—especially spots 1-4—larger, well-defined; hind-marginal fuscous edging much broader, its inner side not sharply defined but more or less diffused. UNDER SIDE.—*Fore-wing*: rufous space of upper-side represented by a reddish tinge occupying a corresponding area; black spots more distinct and rather larger than in typical form. *Hind-wing*: black spots all larger; basal and inner-marginal red border more vivid, bright crimson; broad discal-submarginal fulvous band immediately beyond medio-discal black spots much deeper and brighter in colour; narrow hind-marginal yellow border also brighter.

Abdomen with much less rufous-ochreous on its terminal half, segments 4 to 9 being dorsally and laterally black, with a conspicuous upper-lateral series of ochre-yellow spots.

♀. *Dull-whitish* replaces in both wings the rufous of the

* Ent. Nachr., xx, p. 223 (1894).

♂; black spots as in ♂. *Forewing*: fuscous area duller and with a brownish tinge. *Hind-wing*: a very broad brownish-fuscous hind-marginal border, very diffused on its inner side. **UNDER SIDE**.—Very much duller and paler than in ♂ throughout, and but little differing from that of typical form ♀, except that median inner-marginal space in forewing is of a decidedly paler tint, in accordance with whitish area on upper side.

It is not improbable that the single ♀ of *rubescens* here described is not the normal form of that sex, but a second form of the kind not unfrequent in the genus, where white or whitish more or less suffuses or takes the place of the ordinary red or fulvous ground colour, usually in the hind-wing only.* The normal ♀ will probably be found to resemble the ♀ *asboloplintha* (which is of much duller and fainter colouring than the ♂), except as regards on the upper side a more rufous hind-wing, and a rufous median space in the fore-wing.

The ♂ *rubescens* obviously stands in much the same relation to ♂ *asboloplintha* as *A. acara*, Hewits., does to *A. zetes*, Linn., *A. cepheus*, Linn., to *A. eginopsis*, Auriv., *A. natalica*, Boisd., to *A. pseudogina*, Westw., and *A. areca*, Mab., to *A. egina*, Cram., *vid.*: that of generally brighter colouring and especially of rufous ground colour in the fore-wing instead of fuscous. This relation is associated with a different geographical range in the cases mentioned, the brighter forms being in three instances East and South-East, and the obscurer West African, linking gradations occurring in the intermediate areas; but *rubescens* and *asboloplintha* are found side by side in British East Africa, as are also *areca* and *egina* in Nyassaland.†

The isolated position, as sole representative of a subgroup of his second group of the genus *Acrava*, assigned to *A. asboloplintha* by Aurivillius,‡ does not seem to me to be a natural one, its respective neighbours assigned on either side being *A. satis*, Ward, the last species in sub-

* In a striking variety (*A. pseudolycia*, Butl.) from Congo and Angola of *A. acara*, Boisd., the entire field of both wings—except an ill-defined yellow-ochreous band just before hind-marginal black border of fore-wing, is pure white in both sexes. *A. albo-radiata*, Auriv., the very close Zambesian ally of *A. anemosa*, Hewits., also presents in both sexes some broad pure-white sub-apical rays in the fore-wing, and a large pure-white discal space in the hind-wing.

† Aurivillius, "Rhop. Æthiop.," pp. 508-10 (1899).

‡ *Op. cit.*, p. 90.

group II, and *A. zetes*, Linn., the first species in sub-group IV. I consider that, notwithstanding the extreme attenuation of the upper side hind-marginal border of the hind-wing, the disposition of the spots throughout, and also the broad unspotted fulvous discal-submarginal band of the hind-wing under side—though this feature is developed with exceptional prominence,—bring this form into much closer approximation to *A. stenobæa*, Wallengr., and in a less degree to *A. aglaonice*, Westw., and *A. caldarena*, Hewits.

The new sub-species *rubescens* here described inhabits British East Africa, and the 6 ♂ and 1 ♀ in the Hope Department of the Oxford University Museum, all bear the following data, viz. "About 6000 ft., 15 m. W. of Ft. Hall, Kikuyu Co., Weithaga, capt. and pres. 1907, by K. St. A. Rogers." The tickets further note the dates of capture, *vid.*: of the 6 ♂, Aug. 15, 1906, Feb. 15th and 22nd, and March 12th, 15th and 25th, and of the ♀, March 15th, 1907.

Type of male captured March 12, 1907, of female captured March 15th, 1907, both from Weithaga, in the Hope Department, Oxford University Museum.

Specimens of typical *asboloplintha* in the same Museum bear records of capture in the Tiriki Hills, 20 m. N. of Kisumu (C. A. Wiggins) and on W. shore of Victoria Nyanza, 60 m. along Anglo-German boundary, (1° S. Lat.) (Captain T. T. Behrens, R.E.), all dated as taken in March 1903; and others, in my collection, were captured by Mr. C. W. Hobley at Kaimosi and Nandi on different days during February and March, 1903.

Sub-family NYMPHALINÆ.

Pseudacræa rogersi, sp. nov.

A near ally of *P. eurytus*, Linn. (*hirce*, Drury).

Exp. al. (♂) 1" 7''' ; (♀) 3" 1'''.

♂. *Fuscous*, with yellowish-rufous areas, with black basal and sub-basal spots, and black nervules and internervular rays. *Fore-wing*: black spots of the usual number, size, and arrangement; apical area not so dark as rest of ground colour, slightly suffused with grey; sub-apical rufous bar more median than in *eurytus*, considerably broader and longer, not straight but markedly incurved

inferiorly, extending from costal nervure to 1st median nervule where its termination is much narrowed; on its inner edge this bar anteriorly includes the upper angulated corner of discoidal cell, but is considerably indented at origin of 3rd median nervule; inner-marginal rufous space extends much nearer to base than in *eurytus* and up to median nervure, but is much reduced superiorly, rising only a little above first median nervule; black internervular rays more apparent in apical area owing to the slight greyish suffusion. *Hind-wing*: rufous area greatly enlarged, occupying all the field except a moderately broad inwardly somewhat diffuse fuscous hind-marginal border of almost even width but slightly wider towards anal angle, and a narrow costal ashy-fuscous border from base to about middle; internervular black rays penetrating rufous field much less developed than in *eurytus*, becoming very finely linear at a little distance from inner edge of fuscous border. **UNDER SIDE**.—Very dull and very much paler; fulvous markings of upper side appearing as faint ochrey-yellowish in fore-wing and as dull-whitish in hind-wing, exteriorly ill-defined; apical-hind-marginal areas brownish, in fore-wing clouded with whitish-grey, with the blackened nervules and internervular rays more linear than on upper side; black spots of basal areas conspicuous. *Fore-wing*: discoidal cell grey, but narrow space of ground colour between sub-apical bar and inner-marginal marking pale fuscous. *Hind-wing*: basi-costal border much widened (but not diffuse and ill-defined as in *eurytus*), reddish-brown.

♀. *Fuscous ground darker than in ♂, almost black; fulvous markings of ♂ replaced by pure white ones. Fore-wing*: sub-apical bar straighter and broader than in ♂, but a little shorter—its lowermost spot being reduced by about half, so that it terminates about midway between 1st and 2nd median nervules; the inner edge of this bar does not at all encroach on discoidal cell, but it emits a rather acute dentation between lower radial and first median nervules; inner-marginal white space very much reduced in comparison with the corresponding rufous marking in ♂, except just along inner-marginal edge, scarcely rising to first median nervule, beginning far from base, and with its outline diffuse and ill-defined. *Hind-wing*: hind-marginal border broader and more even than in ♂; internervular black rays more strongly marked. **UNDER SIDE**.

—Ground colour much darker ; white markings of upper side conspicuously reproduced ; internervular black rays better developed. *Hind-wing*: basi-costal border fulvous.

Type of male from 16 miles west of Shimba, near Mombasa, about 1200 ft. Type of female from Rabai, July 28, 1906. The above description was made from these two specimens in the collection of the Hope Department of the Oxford University Museum.

The differences from the West African *Pseudacræa eurytus*, L., presented by this interesting new congener consist mainly in the reversal in the fore-wing of the relative development of the sub-apical bar and the inner-marginal patch, and in the very much greater development of the central patch in the hind-wing. There can, I think, be no doubt that these features indicate very clearly the mimetic approximation of the just-described East African ally of *eurytus* to the common Acræine, *Planema montana*, Butler,* of the same region. *Ps. eurytus*, as is well known, mimics to perfection the abundant *Planema epæa*, Cram. (*gea*, Fab.), of Western Africa, reproducing in each sex the narrow sub-apical bar and high truncated inner-marginal patch of the fore-wings, and the narrow sub-basal patch of the hind-wings, with much exactness both in form and colour. *Ps. rogersi* ♂ has not attained the same close imitation as far as the fore-wing markings are concerned, the retention of an inner-marginal patch diminishing the likeness to *Pl. montana* which has undoubtedly been gained by the quite peculiar position, curvature, prolongation, and inner indentation of the sub-apical bar ; but it is very noticeable that—as in many other cases of mimicry—the ♀ *rogersi* has proceeded further on the mimetic path, the inner-marginal patch in the fore-wings having reached almost as reduced and evanescent a stage as in the ♀ *Pseudacræa imitator*, Trim., in her simulation of *Planema aganice*.

The members of the *eurytus*-group of *Pseudacræa* stand out most prominently among mimetic butterflies in the

* Aurivillius (Rhop. Æthiop., 1899, p. 121) has treated this form as a Variety of the South African *Planema aganice*, Hewits. ; but, considering how very closely allied most of the recognised species of *Planema* are, it seems better to hold it entitled to species rank, because of the much broader bands in both wings—especially in the ♂, where they are moreover of a warm fulvous instead of yellowish or yellowish-white ; in this sex also the basal area on the upper side of the hind-wing is strongly red-tinged.

persistency, exactness, and completeness with which they reproduce the pattern and colouring of their models, the very variable and abundant *Planemæ*—the species of which, though few in number in comparison with the allied *Acrææ*, are very difficult to distinguish satisfactorily. Every variation in both sexes appears to be faithfully copied throughout tropical and sub-tropical Africa wherever the genus *Planema* prevails. Aurivillius (Rhop. *Æthiop.*, pp. 530–1) has recorded eight instances in which this mimicry is palpable, and the case here noted is an addition to that list. The mimicry mentioned by Mr. S. A. Neave (Novit. Zool., xi, p. 333, 1904) of the British East African form of *Planema tellus*, Auriv., by *Pseudacræa terra*, Neave, —captured on the same day at Entebbe—is another recorded instance; and, looking to the rather dull and unattractive aspect of these butterflies, and to the evident comparative rarity of the *Pseudacrææ*, it may reasonably be conjectured that they have not been very assiduously observed or collected, and that the extension of field research will bring to light more mimicries between members of these two genera.

It is a pleasure to name the species here described after the author of the very interesting memoir to which this is an appendix, not only in recognition of his valuable services to African entomology, but in view of his having himself (see above, pp. 508 and 523) pointed out the mimetic relation existing between this *Pseudacræa* and *Planema montana*. Mr. St. Aubyn Rogers has recorded that the ♂ of the *Pseudacræa* was sent to him from Shimba ("16 miles W. of; about 1,200 ft."), while the ♀ was captured by himself at "Rabai, 14 m. N.W. of Mombasa, on July 28, 1906."

Pseudacræa trimenii, Butler.*

The intimate alliance of this form of *Pseudacræa* with the West African *P. boisduvalii*, Doubl., was recognised by me in 1869 (Trans. Linn. Soc. Lond., xxvi, p. 517), and afterwards better explained with the aid of fuller material in 1887 and 1889 (S. Afr. Butt., I, p. 298, and III, p. 405). I showed how closely in both sexes *trimenii*, the South-Eastern form, copied *Acræa acara*, Hewits., of the same region, just as *boisduvalii* mimicked the West African

* Ent. M. Mag., xi, p. 57 (1874).

Acraea zetes, Linn.* I also pointed out, how variable *trimenii* was in one important feature of its mimicry of *acara*, *vid.*: the sub-apical yellow-ochreous bar of the fore-wing, the gradation extending to its complete disappearance in some individuals (*P. colvillei*, Butler), and so far approximating to *P. boisduvalii*, but at the same time exhibiting no abatement in the distinctive feature of bright-red instead of fuscous ground colour in the fore-wing. Later on, in 1898, in the fine collection generously presented to me by my friend Mr. Cecil N. Barker, I found 2 ♀ *trimenii*, having the yellow-ochreous bar of the fore-wing only narrowly developed and mixed with white, but also exhibiting a fuscous suffusion (considerably darker in one example), so that the usual red of the fore-wing only appears near the base. This fuscous clouding gives these examples considerable resemblance to the ♂ *boisduvalii*, but it must be noted that the reduced red of the fore-wing is near the base, not near the posterior angle as in *boisduvalii*.

I am now able, through the kindness of my friend Prof. Poulton, to record the occurrence in a British East African series in the Hope Department of 10 ♂ and 1 ♀ (see the table on p. 527), of a ♂ *trimenii* from "Rabai, near Mombasa (K. St. A. Rogers) captured January 19th, 1907," in which the sub-apical bar of fore-wing is very much reduced and narrowed (while the red spots in the hind-marginal border of hind-wing are unusually large),—having the fore-wing fuscous suffusion largely developed, so that the usual red ground colour is obliterated except for a large sub-quadrate space at posterior angle as in *P. boisduvalii*, and a slight sub-basal trace. This example is a most distinctly intermediate link between the Western and Eastern forms under notice, and probably indicates another of the now rather numerous cases in which presumed distinct species of

* Haase (Untersuch. über die Mimicry, etc., 1893, p. 43, taf. 4, ff. 26–28) showed that *boisduvalii* mimicked *A. egina*, Cram., more closely than *A. zetes*, at any rate as far as the ♂ is concerned, that sex having a red patch along outer portion of inner margin of fore-wing, just as in *egina* ♂, and larger than is exhibited by *zetes* ♂, while in hind-wing larger black spots characterise both *egina* and *boisduvalii*. On the other hand, as regards the presence of red spots in the hind-marginal border of hind-wing, *boisduvalii* resembles *zetes* and not *egina*. It is noticeable also that in the feature last mentioned, the mimicking West African *Papilio ridleyanus*, White, similarly resembles *zetes* more than *egina*.

African butterflies are found to meet and intergrade in the Eastern equatorial belt.

The known range of *P. trimenii* is now a wide one, extending from Port Natal along the East Coast to Mombasa, and thence inland to "Taveta (K. St. A. Rogers), captured December 2nd, 1905" [♂ in Hope Department], and Kibwezi (C. W. Hobley) captured in April 1907.

Family PAPILIONIDÆ.

Sub-family PAPILIONINÆ.

Papilio dardanus, Brown, sub-sp. *tibullus*, Kirby, ♀ form. nov. *dorippoides*.

Exp. al. 3" 8''' (one example).*

Nearest to the ♀ form *trophonius*, Westw., but with the warm-fulvous colouring of both fore- and hind-wings greatly extended, causing a correspondingly large reduction and obsolescence of usual fuscous area in fore-wing, and a similar but less pronounced condition of the hind-marginal fuscous border in hind-wing. *Fore-wing*: fuscous restricted

* This expanse is decidedly greater than that attained by Kikuyu examples of the sub-species *polytrophus*, Jord., that I have measured, which vary (♂) from 2" 10''' to 3" 5''', and (♀) from 3" 2'''-5'''. In size the new ♀ form *dorippoides* thus more approaches that of the Eastern sub-species *tibullus*, and of the Southern sub-species *cenea*, in which both sexes have an expanse varying from 3" 7''' to 4" 3'''. Typical *P. dardanus* from West Coast is larger than any of its sub-species, both sexes expanding from 4" to 4" 6''' ;—one very large ♂ from Fernando Po (with extremely wide black border to the fore-wings) attaining an expanse of 5".

[I think that the sub-species is the Eastern *tibullus*, Kirby, and not *polytrophus*. The latter is found at the higher elevations. The two Nairobi specimens (about 5500 ft.), represented on Plate XXVIII, Figs. 6 and 7, are also much larger than *polytrophus*, while the male (Fig. 7) has the black hind-wing band of *tibullus* and not that of the former sub-species. It is probable that in the Nairobi district *tibullus* occurs at the lower elevation—about 5000-6500 ft., while *polytrophus* captured by Doherty is labelled 6500-9000 ft. There is little doubt that the two areas overlap, and that the two sub-species meet and freely interbreed; furthermore that the resemblance of *dorippoides* to specimens of *polytrophus* is to be explained thereby.

Since the above note was written, Mr. Rogers has informed me that a *trimeni* female form recently taken by him at Nairobi, belongs, he believes, to the large *tibullus* sub-species rather than the small *polytrophus*. E. B. P.]

to (1) a costal border, rather narrow and dark as far as end of discoidal cell, but expanding (with a considerable irroration of fulvous scales) from a little beyond cell to apex into a rather wide form, inferiorly bounded by fifth sub-costal nervule; (2) a very attenuated faintly marked hind-marginal edging, expanding to enclose the two very much enlarged spots of the ground colour between 3rd and 1st median nervules; and (3) a little sparse extra-cellular irroration indicating the position of the usual broad band separating sub-apical oblique bar (which is normally white, but sometimes fulvous as in the example under description, in the *trophonius*-form) from large patch occupying inner-marginal area;—also some sparse fuscous irroration about base and over basal two-thirds of cell; with the exception of the retention on costa of the pale yellowish and whitish origins of usual oblique disco-cellular streak and extra-cellular sub-apical bar, all the rest of the wing is occupied by warm-fulvous—the two markings just mentioned being much enlarged, and, except as regards their costal portions, completely merged and confluent with each other and with the general fulvous area. *Hind-wing*: costal border pale yellowish shading into fulvous field a little below sub-costal nervure and its 1st nervule; hind-marginal border unmixed fuscous only between apex and radial nervule, the rest being closely irrorated with fulvous; all the enclosed internervular paired spots very much enlarged and (with the exception of 1st and 2nd pairs which are creamy-whitish) of the fulvous ground colour. **UNDER SIDE**.—Fulvous area much as on upper-side, but apical and hind-marginal border of fore-wing ochre-yellow instead of fuscous, and a rather wide basal space of hind-wing, from costa to inner margin, pale yellowish. *Fore-wing*: fuscous costal border in cell inferiorly better defined than on upper side, and extra-cellular discal fuscous irroration closer and darker. *Hind-wing*: pale yellowish basal space extending to extremity of cell, slightly irrorated with fulvous about base, along ordinary dark cellular longitudinal streaks, and on outer edge; succeeding it a ferruginous-fulvous discal band, very narrow costally but widening greatly to inner margin, externally blending with the ill-defined inner edge of the hind-marginal border, which is of a slightly greyish-ochreous, with its enclosed paired spots faint and blurred, but enlarged and coloured as on upper side.

This remarkable and most interesting form of the highly polymorphic ♀ of the *tibullus* sub-species of *P. dardanus* is in the Hope Department, and has been most kindly entrusted to me for description by Prof. Poulton. This, the type of the new form, bears the following record:—"1893, Nairobi. C. F. Elliot capt'd. Pres. 1906"; and it was presented to the Hope Department by Mr. E. A. Elliott, F.E.S., brother of the captor. It quite unmistakably mimics the *dorippus*-form of *Danaïs chrysippus* so numerous in British East Africa. One was led to expect as not improbable the discovery of such a form of the ♀ *Papilio* from the fact that in all the continental-African races of *P. dardanus* in which the *trophonius*-form of ♀ occurs a variation has been met with presenting a partly or wholly fulvous instead of white sub-apical bar in the fore-wing, and so in some measure approximating to the *D. dorippus* coloration.* But the non-existence in Western and great rarity in Southern Africa of the *dorippus*-form of *D. chrysippus* rendered it very unlikely that the ♀ *Papilio* in those regions would include any close mimicry of that form, and induced the surmise that if this mimicry did exist, it would be found in that part of the *Papilio*'s range where the *dorippus*-form equalled or exceeded in number the typical form of *D. chrysippus*. This view has now been verified by the discovery in British East Africa of the ♀ *Papilio* above described, in which the likeness to *dorippus* is gained by the extension and confluence of all the rufous-fulvous areas and minor markings, and the consequent diminution and suppression of the ordinary fuscous ground colour.

While it is observable that this likeness is not nearly so exact—especially in respect of the under side—as that exhibited by the ♀ *Diadema (Hypolimnas) misippus*, Linn., yet the fulvous tint is so very close to that of *dorippus* from the same district, and has so far invaded and occupied the hind-marginal borders, that the mimetic effect in life must be great. The resemblance to *dorippus* is in the example under notice so very much more advanced than in any other specimen of the ♀ *Papilio* known to me, that it would not be surprising if individuals still more accurately resembling the model should be found to exist

* See my note on this point as regards the Western and Southern races of the *Papilio* in "S. Afr. Butt.," iii, p. 252 (1889). Cf. Poulton, Trans. Ent. Soc. Lond., 1906, p. 290.

within the range of this *Danaine's* predominance or prevalence.

Everywhere exceptionally productive in differing forms and intermediate variations, the ♀ *P. dardanus* is surpassingly protean, as the smaller-sized sub-species *polytrophus*, in its modifications in the elevated interior of British East Africa, especially on the Kikuyu and other "Escarpments" immediately north and south of the equator. There, as Prof. Poulton has ably demonstrated,* it is possible to trace, with the aid of the many still existing gradations, the highly probable derivation of the more prominent mimetic forms from the primitive *trimeni*-form which is comparatively so little divergent from the male coloration and pattern. The transitional series from *trimeni*,—through (1) *hippocoön* and the partly fulvous-coloured linking variations between *trimeni* and *trophonius*; (2) those between *hippocoön* and *trophonius*; and (3) those between *trophonius* and *dorippoides*—well exemplified by the wholly fulvous-marked *trophonius* described by Prof. Poulton (l. c., p. 290);—constitutes a most striking and convincing illustration of the action of natural selection in the evolution of multiform mimetic adaptation within the limits of one sex only of a single species.

* Trans. Ent. Soc. Lond., 1906, pp. 283-298.

EXPLANATION OF PLATES XXVI-XXIX.

[See *Explanation facing the PLATES.*

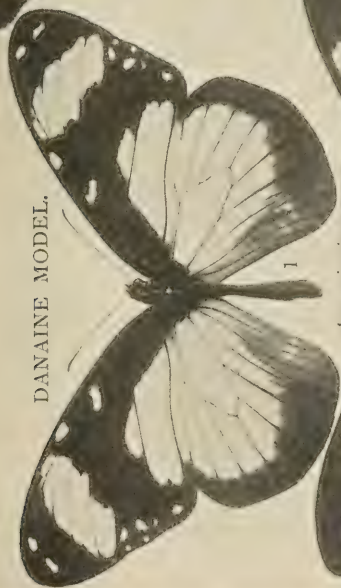
EXPLANATION OF PLATE XXVI.

Mimicry of the Danaine butterfly, *Amauris niavius dominicanus*, by a *Papilio* and two *Nymphalinae* in the Coast District of British East Africa. Another Nymphaline, *Euxanthe wakefieldi*, ♀, with a pattern nearer to *Amauris ochlea* and shown on the same plate with it (Plate XXVII, fig. 2), is during life an outlying member of this combination. The figures were prepared from the best of these 1906 specimens available, regardless of exact locality and date. Some of the time and space relationships of the combination are shown on p. 496. The figured specimens are in the Hope Department, Oxford University Museum.

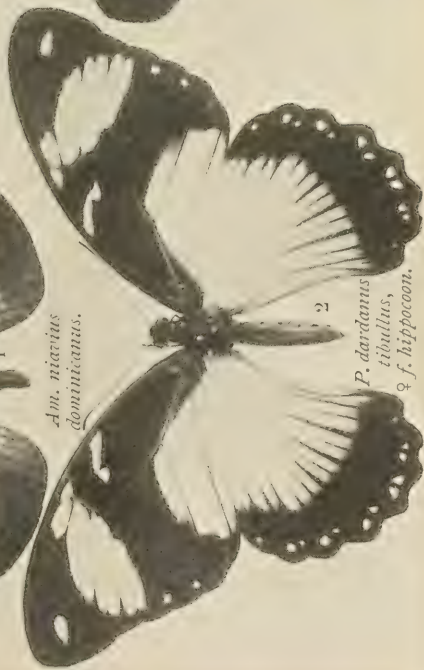
All the figures are $\frac{7}{8}$ of the natural size.

- FIG. 1. *Amauris niavius*, sub-sp. *dominicanus*, ♀: Rabai, about 700 ft., 14 miles N.W. of Mombasa: September 15, 1906. The white markings are seen to be far more sharply defined than those of any of the mimics except the outlying *Euxanthe wakefieldi*, ♀ (Plate XXVII, fig. 2).
- FIG. 2. *Papilio dardanus*, sub-sp. *tibullus*, ♀ f. *hippocoon*: captured November 3, 1906, at the same locality as the model shown in Fig. 1. The submarginal white spots of the hind-wing detract from the mimetic likeness, but are to some extent resembled by the female of *Euxanthe wakefieldi* (Plate XXVII, fig. 2).
- FIG. 3. *Hypolimnas (Euralia) usambara*: captured at the same place and time as the model shown in Fig. 1. This rarest member of the combination lacks the important element of the pattern contributed by the spot in the fore-wing cell. The fulvous patch at the anal angle of the hind-wing barely visible in the figure, together with the much greater development of this colour on the under surface, is probably inconspicuous during flight (see p. 497).
- FIG. 4. *Hypolimnas (Euralia) wahlbergi*: Mangea, about 500 ft., about 75 miles N. of Mombasa: July 19, 1906. Strong secondary resemblances are evident between this and the *Papilio* mimic shown in Fig. 2. Thus the appearance of the inter-nervular rays of the hind-wing, the outline of the chief white patch, and the character of its contour where the black ground colour deepens gradually, are very similar in both *Papilio* and Nymphaline (see Trans. Ent. Soc. Lond., 1902, p. 486, foot-note).

DANAINE MODEL.



Pap. dardanus
dominicanus.



P. dardanus
tiullus,
♀ f. hippocoon.



Eurاليا
usambara.



Alfred Robinson, phot.

All figures are $\frac{1}{2}$ of the natural size.

Eurاليا wahibergi.

Witherby & Co.

The Danaïne, *Pap. dominicanus*, mimicked by a female *Papilio* and by two *Nymphalines*. (Coast District of British East Africa, 1906.)

DANAINE MODEL.



Alfred Robinson, phot.

All figures are $\frac{1}{2}$ of the natural size.

The pattern of the Danaïne, *Am. adha.*, mimicked by *Nymphalides*. Secondary resemblances between the mimics.
(Coast District of British East Africa, 1906.)

Witherby & Co.

EXPLANATION OF PLATE XXVII.

Mimicry of the pattern of the Danaine butterfly, *Amauris ochlea*, by *Nymphaliniæ* (Coast District of British East Africa, 1906). The female of *Euxanthe wakefieldi* (Fig. 2), although possessing a form of the *ochlea* pattern, is during life an outlying member of the *dominicanus*-centred combination represented on Plate XXVI. Secondary resemblances between the other Nymphaline mimics are evident. The figures were prepared from the best of these 1906 specimens available, regardless of exact locality and date. Some of the time and space relationships of the combination are shown on p. 496. The figured specimens are in the Hope Department, Oxford University Museum.

All the figures are $\frac{2}{3}$ of the natural size.

FIG. 1. *Amauris ochlea*, ♂: Rabai, about 700 ft., 14 miles N.W. of Mombasa: May 12, 1906. The outline of the white markings is very sharp. The mimetic resemblance to the model is not as perfect as that seen in the combination figured on Plate XXVI, but in the two species of *Hypolimnas* (*Euralia*) the likeness is striking.

FIG. 2. *Euxanthe wakefieldi*, ♀: captured, December 29, 1906, at the same locality as the model shown in Fig. 1. In spite of the pattern this species with its large white markings is an outlying member of the *Am. dominicanus*-centred combination shown on Plate XXVI.

FIG. 3. *Euxanthe tiberius*, ♀: captured (in coitu), January 19, 1907, at the same locality as the model shown in Fig. 1. This species of *Euxanthe* with its smaller white markings is an outlying member of this combination. The curved direction of the chief white marking of the fore-wing is probably developed in secondary resemblance of the co-mimics shown in Figs. 4, 5 and 6. The fulvous base of the fore-wings, barely visible in the figure, detracts much from the mimetic likeness.

FIG. 4. *Pseudacræa lucretia*, sub-sp. *expansa*: captured at the same place and time as the specimen shown in Fig. 2. The resemblance to *ochlea* is very rough. This species is probably dominant among the mimics, and acts as a secondary model in respect to the form and direction of the chief marking in the fore-wing.

Explanation of Plate XXVII.

- FIG. 5. *Hypolimnias (Euralia) kirbyi*: Jilore, Sabake River, about 200 ft., about 80 miles N. of Mombasa: July 14, 1906. The extraordinarily close resemblance between this and the next species is probably explained by arrested divergence as in many mimetic groups.
- FIG. 6. *Hypolimnias (Euralia) deceptor*: Giryama country, 5-700 ft., about 45 miles N. of Rabai: July 20, 1906. The markings of this species, being larger than in *kirbyi*, produce a closer likeness to *ochlea*, compensated by the more prominent submarginal markings of the hind-wing. The curved marking of the fore-wing probably exhibits in both species the influence of the *Pseudacræa* (Fig. 4).

EXPLANATION OF PLATE XXVIII.

Mimicry of a Danaine model, *Amauris albimaculata* (and probably *echeria* also) by the females, but not by the males, of three species of *Papilio*, in British East Africa (Kikuyu country: 1906-7). The figures were prepared from the best of these Kikuyu specimens available, regardless of precise locality. Some of the time and space relationships of the mimicking species are shown on pp. 509-511. The figured specimens are in the Hope Department, Oxford University Museum.

All the figures are about $\frac{2}{3}$ of the natural size.

- FIG. 1. *Amauris albimaculata*, ♂: Kijabe Forest, about 7000 ft., Kikuyu country: August 3, 1906.
- FIG. 2. *Papilio jacksoni*, ♀: captured at the same place and time as its model shown in Fig. 1.
- FIG. 3. *Papilio jacksoni*, ♂: Nairobi, about 5500 ft.: Feb. 4, 1907.
- FIG. 4. *Papilio echerioides*, British East African form of, ♀: Weithaga, about 6000 ft., 15 miles W. of Fort Hall, Kikuyu country: March 30, 1907.
- FIG. 5. *Papilio echerioides*, British East African form of, ♂: captured at the same place and time as the specimen shown in Fig. 3.
- FIG. 6. *Papilio dardanus*, probably of the sub-species *tibullus*, ♀ form *cenea*: captured at the same place and time as the specimens shown in Figs. 3 and 5. The figured example is somewhat transitional towards the *hippocoon* female form, and a less perfect mimic than is usual in *cenea*.
- FIG. 7. *Papilio dardanus*, probably of the sub-species *tibullus*, ♂: captured at the same place and time as the specimens shown in Figs. 3, 5 and 6. The specimen figured is an interesting variety, possessing a series of small pale sub-marginal spots in the black margin of the fore-wing. The males of *dardanus* usually possess the large sub-apical spot only.



Witherby & Co.

All figures are about $\frac{2}{3}$ of the natural size.

Alfred Robinson, phot.

Mimicry of the Danae, *Am. albinaculata*, by the females of three Papilios in British East Africa (Kikuyu Country, 1906-7.)



RABAI, June 23, 1906.

Alfred Robinson, phot.

All figures are very slightly under natural size.

Witherby & Co.

Mimicry in British East African Butterflies. Resemblances between *Pierinae*, captured at same place and time. Mimicry strengthened in *Neptis woodwardi* from a locality where the Danaine model is predominant.

EXPLANATION OF PLATE XXIX.

Neptis woodwardi more closely mimetic of *Amauris albiguttata* in a locality to the E. of the Rift Valley, where this Danaine is dominant, than by the N.E. shores of the Victoria Nyanza, far to the W. of the Valley. Resemblances between British East African *Pierinae* captured at the same place and time. The specimens are in the Hope Department, Oxford University Museum.

All the figures are very slightly under the natural size.

- FIG. 1. *Neptis woodwardi*, ♂: Weithaga, about 6000 ft., 15 miles W. of Fort Hall, Kikuyu country: May 10, 1907. In the breadth of the ochreous hind-wing band and the size of the white fore-wing spots the pattern of the male, E. of the Rift Valley, is seen to be as closely mimetic of *Amauris albiguttata* (see Plate XXVIII, fig. 1) as is the pattern of the female from further W. (see Fig. 4).
- FIG. 2. *Neptis woodwardi*, ♀: captured August 11, 1906, at the same locality as the specimen shown in Fig. 1. The pattern of the *Amauris* is more closely mimicked by the female *Neptis* than by the male from the same locality, shown in Fig. 1.
- FIG. 3. *Neptis woodwardi*, ♂: Tiriki Hills, 5100 ft., 20 miles N. of Kisumu, N.E. shore of Victoria Nyanza: captured February 26, 1903, by C. A. Wiggins. The mimetic features are seen to be greatly reduced in the male from a locality far W. of the Rift Valley.
- FIG. 4. *Neptis woodwardi*, ♀: captured by C. A. Wiggins, February 27, 1903, at the same locality as the specimen shown in Fig. 3. The mimetic appearance of the western female is seen to be about equal to that of the more eastern male (Fig. 1).
- FIG. 5. *Mylothris agathina*, ♂, under surface: Rabai, about 700 ft., 14 miles N.W. of Mombasa: June 23, 1906. The orange flush at the base of the fore-wings extends on to the costal region of the base of the hind, although this feature is indistinctly shown in the figure.
- FIG. 6. *Belenois thysa*, ♀, under surface: captured at the same time and place as the model shown in Fig. 5. The orange flush at the base of the fore-wings is seen to be larger, of a deeper tint, and more sharply defined than in the model *Mylothris* (Fig. 5). It extends on to the costal border of the hind-wings as in the latter.

Explanation of Plate XXIX.

- FIG. 7. *Leuceronia argia*, ♀, under surface : captured at the same time and place as the model shown in Fig. 5. The orange flush resembles that of the *Belenois* more closely than of the *Mylothris* : it does not extend on to the hind-wings. The mimetic resemblance to the *Mylothris* is very rough as compared with that of the *Belenois*.
- FIG. 8. *Belenois severina* : ♀, Taveta, about 2500 ft. : April 25, 1905.
- FIG. 9. *Teracola vesta*, ♀ : captured at the same time and place as the specimen shown in Fig. 8. The close resemblance between these two very different Pierines is well shown in the figures.

XXIV. *On some of the principal Mimetic (Müllerian) Combinations of Tropical American Butterflies.* By J. C. MOULTON, F.E.S., of Magdalen College, Oxford.

[Read June 3, 1908.]

PLATES XXX—XXXIV.

IN the year 1896 Mr. W. F. H. Blandford, with the help of the late Mr. Osbert Salvin, F.R.S., selected a series of mimetic combinations of Tropical American butterflies from the Godman-Salvin collection. These he exhibited in the same year at the Royal Society and at the Entomological Society of London (Proc. Ent. Soc. Lond., 1896, p. xxxviii). They were also shown and described by him in the following year, during the discussion which followed Dr. F. A. Dixey's paper on "Mimetic Attraction" (Proc. 1897, pp. xx-xxxii and xxxiv-xlvii; Trans. 1897, pp. 317-331). The opinion was strongly expressed at the time that it would be of great advantage if the associations could be kept intact, or at least some permanent record of them preserved. As regards the great majority of specimens exhibited by Mr. Blandford this was found to be impracticable; but Professor Poulton, F.R.S., at once began to collect material for similar groups—from the Hope Collection, from the great series of duplicates presented to the Hope Department by Dr. F. Ducane Godman and Mr. O. Salvin, and from other sources. By 1901 so much progress had been made that he applied to Dr. Godman for his kind help in lending the comparatively few rare species which did not exist in the Hope Department. These were added to the Oxford material, and beautiful photographs of four South American combinations (Plates XXX-XXXIII) were taken by Mr. Alfred Robinson of the Oxford University Museum. In order to give some conception of the analogy between Müllerian resemblances in the Old World and the New, a group of Oriental *Euplwina* with one convergent *Danaine* was photographed at the same time (Plate XXXIV). The South American associations, of which a permanent record was thus made, are

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as follows, tabulated according to their geographical distribution:—

1. North-Central America (Guatemala, Honduras, and Nicaragua); shown on Plate XXX.
2. East Brazil; shown on Plate XXXI.
3. Upper Amazons (Ega); shown on Plate XXXII.
4. Ecuador, Peru, and Bolivia; shown on Plate XXXIII.

The half-tone blocks for these plates were prepared shortly afterwards by Messrs. André and Sleight; but in the press of other work Professor Poulton has been unable to publish an account of the material or to describe the plates. Early in the present year he invited me to undertake this task, which I need hardly state has proved an extreme pleasure, in view of the exceptional interest of these mimetic associations. I would here like to take this opportunity of recording my sincere gratitude to him, first, for allowing me the privilege of writing this paper, and secondly, for all the kind help and trouble he has shown in assisting me to produce it. The difficulties of a first entomological paper, so alarming to the beginner, have all been made easy by his kindly surveillance. The following associations, although arranged in a different order, are reproduced with but little change from Mr. Blandford's paper (*Proc. Ent. Soc. Lond.*, 1897, pp. xxii-xxvii): it will be noted, however, that while his combinations were wholly composed of butterflies, certain examples of Heterocerous mimics, as well as a few additional Rhopalocera, have been incorporated in the tables of the present paper. Mr. Blandford spoke of these mimetic associations as "groups," but I have adopted Professor Poulton's suggestion that they should be called "associations" or "combinations."*

In the tabular form in which the associations are set forth below, the Ithomiine models are shown on the left and their mimics on the right; the whole series forming a large combination with a single type of pattern.

* "Essays on Evolution," 1908, Essay X, p. 293:—"In this essay the word 'group' is employed to express an arrangement based on affinity, the word 'combination' or 'association' to express an arrangement founded on bionomic relationship. Thus a genus or family is spoken of as a group, a set of Müllerian models and mimics as an association or combination."

COMBINATION I. (Shown on Plate XXX.)

North Central American Type—Guatemala, Honduras
and Nicaragua.

ITHOMINÆ.

Tithorea sp.

Melinæa imitata, Bates
(Figs. 1 and 2).

Mechanitis doryssus, Bates
(Figs. 3 and 4).

Mechanitis lycidice, Bates

Ceratinia dionæa, Hew. (Figs.
5 and 6).

Ceratinia fenestella, Hew.
(Figs. 7 and 8).

DANAINÆ.

Lycorea atergatis, Doubl. and
Hew. (Figs. 13 and 14).

NYMPHALINÆ.

Protogonius cecrops, Doubl.
and Hew. (Figs. 21 and 22).

Eresia phillyra, Hew. (Figs.
19 and 20).

HELICONINÆ.

Heliconius telchinia, Doubl.
and Hew. (Figs. 9 and 10).

Eueides zorcaon, Reak. (Figs.
11 and 12).

PIERINÆ

Dismorphia praxinæ, Doubl.
(Figs. 17 and 18).

*Perrhybris (Mylothris) ma-
lenka*, Hew. (Figs. 15 and
16).

HYPSIDÆ (Moth).

Pericopsis angulosa, Walk.

The only addition to Mr. Blandford's list, except the Pericopid moth, is *Mechanitis lycidice*, Bates, which this authority places in an intermediate position between the above North Central-American and a South Central-American (Costa Rica to Panama) combination. He includes four other species in this intermediate position, but these are so much nearer to the southern combination that no mention of them is necessary here. *M. lycidice*, however, is extremely variable, and, in Guatemalan specimens, the black bar of the hind-wing is as a rule well developed, as in the northern Müllerian association. On the other hand, the absence of this feature in many Costa Rican examples permits their introduction into the southern combination.

It will be seen from the accompanying Plate XXX that the general pattern of this association consists of a conspicuous light brown (fulvous) ground colour, crossed by parallel black bands and oblique bars, the apex of the fore-wing being relieved by two yellow bars between the last-mentioned black markings. While it is apparent that all the members of this association have gradually become drawn together into one general pattern, we can also clearly see how single constituent species have followed others in minor characteristics. A specially remarkable illustration of this is afforded by the strong resemblance between *Melinæa imitata* (Figs. 1 and 2) and *Heliconius telchinia* (Figs. 9 and 10). Here, the broken yellow sub-apical bands of the *Melinæa* are closely followed by those of the *Heliconius*. On the under side of the fore-wing, an irregular series of white spots appears along the hind margin of the *Melinæa*, and similar spots are present although very faintly developed and more marginally placed along the anal portion of the hind margin in the *Heliconius*. The same likeness is found along the hind margin of the hind-wing, where however the usual radiating white streaks of the *Heliconius* are shortened into a rough resemblance to the rounded or oval spots of the *Melinæa*.*

The exceptionally close resemblance between two such widely different genera as *Melinæa* and *Heliconius*, as exemplified by *M. imitata* and *H. telchinia*, affords a good instance of the entire independence of affinity and mimicry, as Professor Poulton points out in "Essays on Evolution," 1908, p. 235. Thus two Ithomiine genera (*Mechanitis* and *Ceratinia*), with four different species (including *M. lycidice*), bear a general likeness to the *Melinæa* pattern, and yet none of them afford nearly so close a resemblance as that exhibited by the *Heliconius*. Hence the Ithomiine genus *Melinæa* is far more closely resembled by its Heliconine mimic belonging to a very different sub-family, than by any Ithomiine which contributes a member to the association. Similarly the *Heliconius* bears a much closer likeness to the Ithomiine model than to the nearly allied *Eucides*.

My attention was directed by Professor Poulton to the fact that the second Heliconine of this association, *Eucides zorcaon* (Figs. 11 and 12), also presents in one special detail a resemblance to the Danaine, *Lycorea atergatis*

* See Poulton, "Essays on Evolution," 1908, p. 350.

(Figs. 13 and 14), in this respect its probable model. I refer to the peculiar ochreous colouring of the oblique markings in the fore-wing apical region,—markings which are of a bright yellow tint in nearly all the other constituents of the combination. It should be noted, however, that ochreous markings in this region are characteristic of many species of both *Eueides* and *Lycorca*. As regards their form, the pale markings of the fore-wing present certain similarities in these two species. An irregular somewhat hour-glass-shaped spot appears at the end of the cell of each species, as also an elongate spot with a median constriction near the anal angle. The form of these and the other markings is very variable, but their general likeness is noticeable. It will be found in other combinations considered in the later pages of this paper that the species of *Protophonus* are generally specially associated with those of *Lycorca*. Thus in the present instance *P. cecrops* (Fig. 21) not only possesses the ochreous markings towards the apex of the fore-wing, but the marginal hind-wing spots are more strongly developed on the upper surface than in any other species of the association except *Lycorca atergatis*.

Ochreous bars also appear in the female of the Nymphaline, *Eresia phillyra* (Fig. 20), which in other respects has evidently been drawn after *Ceratinia dionæa* (Fig. 6), with its row of distinct yellow spots along the hind margin of the fore-wing. Interesting features of the male *Eresia* (Fig. 19) are the narrow hooked fore-wing, and the absence of special paleness in the apical markings, both suggesting the influence of some *Dione* or *Eucides* (perhaps *E. aliphæra*, Godt.).

Dismorphia praxinæ (Figs. 17 and 18) presents several points of interest. First, the size and general shape suggest *Mechanitis doryssus* (Figs. 3 and 4) as the model, as was pointed out by Godman and Salvin:—"The female has a colour resemblance to *Mechanitis doryssus*, a species abundant throughout the same area" ("Biologia Centrali-Americana, Rhopalocera," 1887-1901, Vol. II, p. 176). On the other hand, the yellow apical markings follow far more closely those of *Melinæa imitata* (Figs. 1 and 2), and its mimic, *Heliconius telchinia* (Figs. 9 and 10), especially the latter. The dark bands of both wings correspond more nearly with those of the *Heliconius* than with the narrower markings of the *Mechanitis*.

The *Perrhybris* (Figs. 15 and 16) can only be regarded

as an outlying member of the association; for the male (Fig. 15) does not mimic at all on the upper surface, while the female (Fig. 16) is rather a rough mimic, the wings being comparatively broad and the dark median band of the hind-wing but feebly developed. The mimicry of the under surface of the male *Perrhybris* is discussed by Dr. F. A. Dixey in Trans. Ent. Soc. Lond., 1894, pp. 286 and 320; 1896, pp. 67-72. It is characteristic of this genus, that while invariably entering a Müllerian association, it never presents more than a rough mimetic resemblance. The peculiar serration of the inner border of the deep black hind-wing margin in the female is discussed on p. 594.

The moth (*Pericopsis*) is also but a rough mimic; for in it no black median band crosses the hind-wing, although the marginal border is of much greater breadth, and thus the unbroken discal space of ground colour is barely noticeable.

Evidence that members of this association frequent the same locality and may be mistaken for one another by the captor, exists in the Hope Department, where one *Melinæa imitata*, two *Heliconius telchinia*, and an example of the moth, *Pericopsis angulosa*, all taken in Honduras in 1895, had been put together as a single species!

A general survey of the association shows that the closest resemblance exists between *Melinæa imitata* and *Heliconius telchinia*. A second pair—although not nearly so close—is provided by *Lycorea atergatis* and *Euwides zorcaon*; a third by *Ceratinia dionæa* and *Eresia philyra*, ♀. Lastly, *Dismorphia praxinoc* ♀ presents a general resemblance to *Mechanitis doryssus*, *Melinæa imitata* and *Heliconius telchinia*. The *Perrhybris* and moth are, as previously stated, only rough mimics of the same pattern.

COMBINATION I. A.

The Guiana Type. British, Dutch and French Guiana.

A detailed account of this association is unnecessary; for it has been described in much detail and illustrated with many beautiful plates by Mr. W. J. Kaye, F.E.S. (Trans. Ent. Soc. Lond., 1906, p. 413). A Nymphaline member, *Eresia eunice*, Hübn., was however accidentally omitted by this naturalist, who has now kindly provided me with the following interesting note on it:—"Up till the date of my paper, October 1906 (Trans. Ent. Soc. Lond., 1906, p. 413), I had received about twenty-five specimens of this species. None of the specimens show

any tendency to melanic hind-wings, but the females are certainly more heavily barred than the males. The latter show a strong tendency to a breaking up of the bar into a series of spots much as in the male of *Eucides nigrofulva*, Kaye, *vide* Pl. XXIII, fig. 13. I do not expect that *Eresia eunice* usually sits with the *Melinæas*, etc., on the white flowers of *Eupatorium macrophyllum*, because I have stopped Roberts sending collections from off these flowers, but still I get a fair number of *E. eunice*. There is not the slightest doubt however that it is a member of the group and derives its colouring therefrom."

COMBINATION II.

The East Brazilian Type.

This type is split up by Blandford into two sub-divisions, (a) with yellow apical spot or spots in fore-wing. (b) With white markings in the same position. The following table shows the constituent species arranged as in Combination I.

(a) *The apical spots on the fore-wing yellow.*

ITHOMIINÆ.	DANAINÆ.
<i>Tithorea</i> , sp.	<i>Lycorea halia</i> , Hübn.
<i>Melinæa ethra</i> , Godt.	NYPHALINÆ.
<i>Mechanitis nesæa</i> , Hübn.	<i>Eresia esora</i> , Hew.
<i>Napeogenes xanthone</i> , Bates.	<i>Eresia</i> , sp.
<i>Ceratinia laphria</i> , Doubl.	HELICONINÆ.
	<i>Heliconius dryalus</i> , Hopff.
	<i>Eucides dianasa</i> , Hübn.
	PIERINÆ.
	<i>Dismorphia astynome</i> , Dalm.

(b) *The apical spots on the fore-wing white. (Shown on Plate XXXI.)*

ITHOMIINÆ.	NYPHALINÆ.
<i>Mechanitis lysimnia</i> , Fabr.	<i>Protogonius drurii</i> , Butl.
(Figs. 1 and 2).	(Figs. 10 and 11).
<i>Napeogenes euryanassa</i> , Feld.	HELICONINÆ.
(Figs. 5 and 6).	<i>Heliconius narcæa</i> , Godt.
<i>Ceratinia daeta</i> , Boisd. (Figs.	(Figs. 7 and 8).
3 and 4).	<i>Heliconius polychrous</i> , Feld.
	(Fig. 9).

In sub-division (b) another *Heliconius*, *H. polychrous*, Feld., and a Nymphaline, *Protogonius drurii*, Butl., have now been added to Blandford's list.

The principal characteristics of this association are the presence of a broad yellow band parallel to the costal border of the hind-wing, and an oblique bar crossing the fore-wing and passing from near the centre of the costa towards the hind-margin. This nearly median bar is succeeded by a large apical spot, or group of spots, sometimes yellow [sub-division (a)], and sometimes white [sub-division (b)].

Sub-division (a). In this association the Danaine, *Lycorea halia*, affords a striking resemblance to *Melinæa ethra*, although the hind-margin of the hind-wing has not lost its border of white spots. As noticed in Combination I, the *Lycorea* possesses a buff or ochreous tint in place of the usual bright yellow markings so typical of this association.* It is also noteworthy that the yellow of the *Melinæa* is slightly duller than that of the association generally. *Mechanitis nesæa*, besides being smaller, differs slightly from the *Melinæa* in having two small yellow sub-apical spots in addition to the yellow apical patch; there is also a far smaller development of black markings on the basal side of the yellow in the fore-wing; but in spite of these differences the superficial resemblance is very close.

A very good Pierine mimic, *Dismorphia astynome*, enters this association, having in the female the yellow apical spot just as in *Melinæa ethra*. It has furthermore acquired the typical Ithomiine shape with narrow wings. The yellow bar of the hind-wing is not strongly developed, but sufficiently to bring the species well within the combination. The male also has followed the female into the association; although here the hind-wing band is far less yellow and the ancestral white still prevails in the costal area of the hind-wing as in the male of *D. praxinæ*. As in this latter species, the white patch is almost certainly hidden in flight and at rest. The male lacks the apical spot of the fore-wing, although a slight suggestion of it is indicated by a few yellow scales in that region.

* The hind-wing band is not nearly so bright in the *Lycorea* as in other members of the association. Prof. Poulton has given reasons for the belief that the tint may have been even duller about eighty years ago. See Ann. Mag. Nat. Hist., ser. 7, vol. xiii, 1904, pp. 359, 360.

An interesting point emerges in connection with the ancestral white of *Dismorphias* of this pattern. Besides the white portion on the upper side of the hind-wing mentioned above, a white patch occupies the inner marginal area of the fore-wing under side. The meaning of this retention of the white on parts of the surface hidden by the overlapping of the wings is very clearly explained and illustrated by Professor Poulton in his paper "Natural Selection the Cause of Mimetic Resemblance and Common Warning Colours," Linn. Soc. Lond., Journ. Zool. vol. xxvi, p. 606, pl. 40. In addition to the white patches, there are other distinct traces of the ancestral white on the under side of both wings. These persistent traces are formed by a few white scales—easily visible to the naked eye—near the hind margin of the hind-wing and especially at the apex of both wings. The general appearance of the under side suggests that it may possess a cryptic significance, which is an argument against the unpalatability of this Pierine.*

Sub-division (b). All the *Ithomiines* resemble each other except for the fore-wing apical markings (Plate XXXI, figs. 1–6). *Heliconius narcæa* (Figs. 7 and 8) perhaps follows *Mechanitis lysimnia* (Figs. 1 and 2) more closely than it does any of the other *Ithomiines* of this sub-division: its likeness to *Melinæa ethra* of sub-division (a) is far stronger. The *Mechanitis* does not exhibit that tendency towards transparency which is so characteristic of large numbers of the *Ithomiinæ*, and is readily noticeable in the *Ceratinia* (Figs. 3 and 4) and *Napæogenes* (Figs. 5 and 6) belonging to this combination. *Heliconius polychrous* (Fig. 9) must be considered a rough mimic. Its principal defect, which is not very apparent in the figure on Plate XXXI, is the great reduction of the tawny colour and the corresponding increase in the black and yellow markings of both wings. *Protopogonius drurii* (Figs. 10 and 11) again is a poor mimic, as is customary in that genus. It is, as is also usual in the genus *Protopogonius*, the only member of its association with an obviously and strongly cryptic under surface. The yellow band across the hind-wing is easily traceable, although neither sharply defined nor bordered by black, as in the models. The white apical spot is distinct, and the white spots in the hind margin of

* See R. Shelford in Poulton's "Essays on Evolution," 1908, pp. 351, 353.

the hind-wing come out in this Nymphaline as in the *Lycorea*. It also follows the *Lycorea* in the more ochreous shade of the yellow markings of the forewing.

With the object of showing more forcibly that these several species do actually occur together in one area, and have in many cases been caught on the same day, I have appended a list of the specimens collected in Brazil, between 1825 and 1830, by W. J. Burchell. It is a striking fact that one should have to go back to a collection eighty years old in order to gain the best available proof that these butterflies are associated together in space and time!

In addition to many members of both sub-divisions, Burchell took a fine series of the Pierine, *Perrhybris* (*Mylothris*) *pyrrha*, Fab. This species has not been included in the list on p. 591, because the apical spot is absent. Like all members of its genus, it is but a rough mimic, and, as regards the upper surface, a mimic only in the female. Just below the apical region, there is visible, near the hind margin of the fore-wing, the apparent incipient separation of a yellow spot from the oblique bar—a separation which is complete on the under surface. On this account the species is placed in the table of Burchell's captures as printed on p. 595, next to the sub-division with yellow apical spots.

H. W. Bates published the following interesting note on the habits of this species in his paper on the "Insect Fauna of the Amazon Valley" (Journal of Entomology, December 1861, pp. 235, 236): "It inhabits the shades of the forest; but the males are found also in open places, and resort to the moist margins of puddles and streams; the females I have never seen except within the forest; they are much rarer than the males, and are coloured in imitation of certain Heliconidæ* found in the same localities. The species has a wide range; it is common at Rio Janeiro and Bahia; specimens from those localities I find do not differ from those taken by myself in the Amazon region."

An interesting feature is noticeable in the hind-wing where the broad black margin is deeply serrated in its

* In the term "Heliconidæ," Bates included the *Ithomiinæ*, the *Lycoræini* (a section of the *Danainæ*) and the *Heliconinæ*. The two former he called "*Danaoid Heliconidæ*," and the third "*Acræoid Heliconidæ*."

LOCALITY.	DATE.	White apical spots in fore-wing.				Yellow apical spots in fore-wing.				No apical spots in fore-wing.	
		ITHOMININÆ.	MECHANITINÆ.	STYLOPAGININÆ.	HELICONINÆ.	ITHOMININÆ.	DANAINÆ.	PIERINÆ.	PIERINÆ.		
		<i>Cyrtolista caryocassia</i> .	<i>Mechanitis lysimacha</i> .	<i>Stylopagania clausi</i> .	<i>Heliconius narcaus</i> .	<i>Melipotis ethra</i> .	<i>Eucroea halia</i> .	<i>Disomorphia astyanax</i> .	<i>Pyrrhobolis (Mylothris) pyrrha</i> .		
Minas Gerais.	Oct. 14, 1825	...	1 + [1]	...	...	...	...	...	...
"	Oct. 15 "	...	2	...	...	...	...	...	...
"	Oct. 19 "	1	...	...	[1, Oct. 21]	...	...	...	...
"	Oct. 29 "	...	...	...	1 + [1, Oct. 30]	...	...	...	...
"	Nov. 4 "	...	3	...	...	...	...	...	...
"	Nov. 7 "	...	...	...	1	...	...	...	...
"	Nov. 10 "	...	2	...	...	...	1	...	...
"	Nov. 12 "	1	...	...	...	...	...	...	...
Rio de Janeiro	Dec. 6 "	...	1	...	...	...	...	...	...
"	Dec. 31 "	...	...	...	...	...	...	...	...
Organ Mountains	Jan. 31, 1826	...	...	...	...	...	...	...	...
"	Feb. 8 "	...	1	...	1	...	...	...	...
"	Feb. 9 "	...	1 + [1]	...	...	...	[1]	...	...
"	Feb. 12 "	...	1	...	...	...	...	...	...
"	Feb. 16 "	...	1	...	...	...	...	...	...
"	Feb. 21 "	...	1	...	...	...	...	...	...
"	Feb. 28 "	...	1	...	...	...	...	...	...
River Magé	Mar. 1 "	...	1	...	...	...	...	...	...
"	Mar. 7 "	...	1	...	...	...	...	...	...
Rio de Janeiro	Mar. 9 "	...	1	...	...	...	...	...	...
"	Mar. 10 "	...	1	...	...	...	...	...	...
"	Mar. 13 "	...	1	...	...	...	...	...	...
"	Mar. 15-17 "	...	...	...	...	...	...	...	...
"	Mar. 19 "	...	...	...	...	...	...	...	...
"	Mar. 21 "	...	...	...	1	...	...	...	...
"	April 1 "	...	...	...	1 + [1]	...	...	...	...
Santos	Sept. 15 "	...	...	...	[1]	...	...	...	...
"	Sept. 26 "	...	...	...	...	...	...	...	...
Cubatão	Dec. 14 "	9 + [2]	...	...	...	...	...	...	...
"	Dec. 16 "	...	1	...	...	...	...	...	...
North of R. Paulo	Aug. 29, 1827	...	1	...	...	...	...	...	...
Lanboso to Bréjo	Oct. 2 "	...	...	1	...	...	...	...	...
Goyaz	Oct. 30 "	...	...	...	...	...	...	...	...
"	Dec. 21 "	...	...	...	...	...	...	...	...
"	Mar. 4, 1828	...	...	...	...	...	...	...	...
Para	June 16, 1829	...	1	...	...	...	...	...	...
"	July 29 "	...	...	...	...	...	...	...	...
"	Dec. 10 "	...	...	...	1	...	...	...	...
"	No data.	1	...	...	...	...	...	...	...
Totals	...	12 + [2]	6	21 + [2]	10 + [5]	1	8 + [1]	3	27 + [2]		

Numbers in square brackets denote the existence of specimens which cannot now be traced. Their data are contained in a list prepared under the direction of the late Professor Westwood.

* Two specimens with this date are recorded in Burchell's note-book as well as in Westwood's list.

costal region, resulting from invasions of the orange-brown ground colour. This suggests the possible transition from a special warning character or aposeme acquired by the *Perrhybris* on the way from the ancestral Pierine white towards this tawny and yellow, black-barred association. Slight traces of this same feature are visible in the *Dis-morphia* of this association; and the character is strongly marked in the female of *Perrhybris malenka* of the Guatemala-Nicaragua Combination (see Plate XXX, fig. 16).

The most perfect resemblance between any two species in the above table (in spite of the differently-coloured apical spots) is that between *Melinara ethra* and *Heliconius narcava*: the likeness is exceptionally strong. Mention has been made already on p. 589 of the occurrence of a marginal row of white spots in both *Protogonius* and *Lycorea*, and of the further indication of resemblance seen in the buff-ochreous fore-wing markings which in these two species replace the usual striking yellow. In spite of the apical patch of *P. drurii* being white (while that of *L. halia* is ochreous) it seems probable that the *Lycorea* is the chief model of the Nymphaline.

The chief characteristic feature of this association—the yellow hind-wing band—appears independently in *Mechanitis lydidice* of Guatemala, which has already been shown to enter two of the Central American combinations (see p. 587). Many specimens of a fine series in the Hope Collection possess this yellow band in a well-developed condition. In other numerous specimens it is marked to a lesser degree, while in others again it is entirely absent, as we should expect in a member of the more northern combinations.

We now pass from a warning pattern characteristic of the country to the south of the Amazon mouths to a very different type developed beside its upper waters.

COMBINATION III. (Shown on Plate XXXII.)

The Upper Amazons (Ega) Type.

ITHOMINÆ.

Tithorea harmonia, Cram.

Melinæa pardalis, Bates
(Fig. 3).

Melinæa pardalis, Bates, sub-
sp. nov. *madeira* (Fig. 2).

Mechanitis egaënsis, Bates
(Figs. 4 and 5.)

Ceratinia fluonia, Hew.

DANAINÆ.

Lycorea cinnamomea, Wey-
mer (Fig. 1).

NYMPHALINÆ.

Protogonius castaneus, Butl.
(Figs. 10 and 10a).

HELICONINÆ.

Heliconius pardalinus, Bates
(Figs. 8 and 9).

PIERINÆ.

Dismorphia egaëna, Bates
(Figs. 6 and 7).

The only addition to Blandford's list is a sub-species* of *Melinæa pardalis* from the Rio Madeira to the S.E. of Ega. The principal features of this association are the darkening of the ground colour into a mahogany or chestnut tint, and the mottled appearance of the outer half of the fore-wing, this latter effect produced by broken irregular yellow markings on a dark background. The black markings of the North-Central American type are still visible on the hind-wing, but they are more heavily developed and often tend to fuse together, as in the Guiana Combination. As usual, the *Melinæa* and *Heliconius* stand out as the central pair, *H. pardalinus* (Figs. 8 and 9) resembling *M. pardalis*, sub-sp. *madeira* (Fig. 2) in a most remarkable manner; but the whole of the Ithomiines form with the *Heliconius* and the *Dismorphia* (Figs. 6 and 7) a wonderfully close combination. The yellow spot at the anal angle of the fore-wing in the two species of *Melinæa* appears in the *Lycorea* (Fig. 1), while in the *Heliconius* two spots are placed at the apex of the hind-wing. In the natural position of

* A brief description of this form will be found in the Appendix on p. 604.

the wings during flight or at rest with wings expanded, the upper of these two is doubtless concealed and the lower spot then probably represents that on the fore-wing of the *Melinæa*. The male Pierine *Dismorphia egaëna* (Fig. 6) bears a similar spot at the apex of the hind-wing, and probably mimics the *Heliconius* in this respect. The *Protogonius* (Fig. 10), as before, is only a rough although a most unmistakable mimic, and as in the previous associations, the *Lycorea* (Fig. 1) appears to act as its principal model, both species being conspicuous in the combination for their hind-wing marginal spots and for the ochreous markings of the fore-wing.

The transition from this association to the next is probably in part preserved in a separate Peruvian association, in which the mahogany ground colour has been replaced by orange-fulvous; the black bands of the hind-wing have fused or half-fused, while the apical yellow markings in the fore-wing are much reduced and wanting altogether in some cases. Thus the three following Peruvian species would be considered obvious members of the Ega association except for the substitution of an orange-fulvous ground colour for the Ega mahogany tint. These are *Ceratinia anastasia*, Bates, a Peruvian form of *Melinæa pardalis*, Bates, and *Heliconius floridus*, Weym. All three species possess both yellow apical and black hind-wing markings, which are very similar to those of the species from Ega. A further stage in this transition is suggested by two species of *Melinæa* (*M. phasiana*, Butl., and *M. orestes*, Salvin), and one *Heliconius* (*H. arcuella*, Druce), in all of which the yellow apical markings are wanting. Except for this deficiency they resemble the former trio. *Tithorea cuparina*, Bates, may represent the next step; for in it the apical region is black and free from all traces of the mottled appearance. The black hind-wing, typical of the next association, is not however found in this *Tithorea*, which still retains the black bar placed upon an orange-tawny ground colour.

These interesting transitional forms lead on to the last Neotropical Association considered in this paper.

COMBINATION IV. (Shown on Plate XXXIII.)

The Bolivia, Ecuador and Peru type.

ITHOMINÆ.

Melinæa mothone, Hew. (*cydippe*, Salv.)* (Figs. 1 and 2).

Mechanitis deceptus, Butler (*methone*, Salv., nec Hew.) (Figs 4 and 5).

Ceratinia semifulva, Salv.

Napeogenes achæa, Hew.

Hyposcada fallax, Staud. (Fig. 3).

SATYRINÆ.

Pedaliodes praxithea, Hew.

Pedaliodes triaria, G. and S.

NYMPHALINÆ.

Protogonius semifulvus, Butl. (Figs. 14 and 15).

Eresia ithomiola, Salv. (Figs. 12 and 13).

Eresia murena, Staud.

HELICONINÆ.

Heliconius aristiona aristiona, Hew. (Figs. 6 and 7).

Eucides acacetes, Hew. (Figs. 8 and 9).

ACRÆINÆ.

Acræa acipha, Hew. (Figs. 10 and 11).

PAPILIONINÆ.

Papilio bachus, Feld. (Figs. 16 and 17).

HYPSIDÆ (Moth).

Pericopsis hydra, Butl. (Figs. 18 and 19).

Castnia pellonia, Druce.

Blandford's list is here increased by *Hyposcada fallax*, the two Satyrines, *Eresia murena*, and the two moths, while *Napeogenes achæa* almost certainly represents his unnamed species of this genus.

In this large and interesting combination the original striped pattern has entirely disappeared, and the warning

* I here follow Butler's interpretation of Hewitson's figure of *Mechanitis mothone* in "Exotic Butterflies," vol. i, Pl. XLVII, fig. 14. Hewitson's type has not been discovered, but the figure appears to represent a male *Melinæa*, and not a female *Mechanitis*. Blandford's list adopts the synonyms.

appearance consists of a very dark ground colour crossed by a broad black-spotted band of orange-tawny, from the centre of the costa to the anal angle of the fore-wing and apex of the hind. Although a very strong general likeness runs through the whole combination, there are also close resemblances between special members, as for instance the large *Heliconius aristiona* (Figs. 6 and 7), which evidently follows *Melinæa mothone* (Figs. 1 and 2). The spots in the oblique band are superficially alike, while in both species there is very little orange-tawny colour at the apex of the hind-wing.

Another special internal association is formed by *Hyposeuda fallax* (Fig 3) and *Eresia murena*, probably a southern form of *E. ithomiola*, Salv. Here the spots in the band are only two in number, both faithfully reproduced in *murena*. Again, as regards the orange-tawny area at the apical region of the hind-wing, the Ithomiine is followed by the *Eresia*. *Eresia murena* is not represented on Plate XXXIII; and the two forms of *Eresia ithomiola* ♀ there figured are not such close mimics of *H. fallax*. It will be seen by a glance at figures 12 and 13 on Plate XXXIII that the outer margin of the oblique tawny band becomes pale, due to the appearance of a yellow tint in these two *Eresias*, which on that account must be specially associated with the *Papilio* (Figs. 16 and 17), and moth (Figs. 18 and 19), considered on p. 601.

The *Protopogonius* (Fig. 14) and the *Papilio* (Fig. 16) are rougher in their resemblance, and perhaps tend towards the *Heliconinæ* and especially the *Eucides* (Fig. 8), rather than the *Ithomiinæ* (Figs. 1-5).

An interesting feature of this *Protopogonius* is the absence of white spots in the hind margin of the hind-wing. The reason is probably to be found in the absence of a *Lycoreu* from this association. These spots may be considered as ancestral in the *Protopogonius*—faint traces of them can still be detected even in *P. semifulvus*—and the presence of a similarly-spotted *Lycoreu* in the associations tends towards their retention by the Nymphaline. In this combination (IV), however, in the absence of a *Lycoreu*, the *Protopogonius* loses its marginal spots and enters more closely than usual into the general mimetic association.

Professor Poulton has also pointed out to me that in Bolivian specimens of *Mechanitis decrptus*, small white sub-marginal spots are retained in the sub-apical region of the

under surface of the fore-wing, while these markings are absent or occasionally just visible in examples of the same species from Peru and Ecuador. Here the ancestral feature, obsolete in more northern localities, is preserved in the south. In some Bolivian specimens these spots extend round the hind margins of both wings.

Other species showing a closer resemblance within the association are seen in the moths, *Pericopis hydra* (Figs. 18 and 19), *Castnia pellowia*, and the *Papilio* (Figs. 16 and 17). In all these, yellow markings appear at the costa of the fore-wing extending more or less completely along the outer margin of the oblique tawny band, and, except in the *Castnia*, yellow spots are developed along the hind margin of the hind-wing. These features are generally wanting from Combination IV, although, as regards the fore-wing, *Eresia ithomiola* ♀ (Figs 12 and 13) approaches the *Papilio* and the moths. The resemblance of the *Castnia* to *Papilio bachus* is much closer than that of the *Pericopis*. The yellow outer border of the orange-tawny oblique band of the fore-wing in the above constituents of Combination IV, as also in the majority of the specimens of *Napeogenes achæa*, is undoubtedly transitional towards Blandford's "7. Central Colombian modification" of "6. Ecuador Type,"—the latter name being applied by him to the association now being considered. From the evolutionary point of view, however, the yellow fore-wing marking of the Central Colombian association is certainly ancestral, and its absence in Ecuador, etc., a comparatively recent modification. The relationship between these two combinations, distinguished by the presence or absence of the yellow margin to the oblique fore-wing band was clearly pointed out by H. W. Bates in the historic memoir on Mimicry (Trans. Linn. Soc., Lond., 1862, vol. xxiii, Pl. III, p. 514):—"Some of the close resemblances amongst the *Heliconidæ* themselves seem to be kept up by their varying in a precisely similar way. There is a very singular instance in three species of three different genera, *Melinæa*, *Mechanitis* and *Heliconius*, which are all in East Peru, orange and black in colour, and in New Granada orange, black and yellow. This seems to be a case of coincident, simple variation; for if three forms are quite alike in colours, it is conceivable that they may vary alike when placed under new conditions by migration. Our *Leptulides* have been shown not to vary precisely like their

models ; and therefore the case just quoted does not throw any difficulty in the way of the explanation I have given ; but it is a very extraordinary one."

This passage is a good example of the difficulties in which Bates was placed by the mimetic likeness between specially protected groups. Bates' suggested interpretation seems to indicate that the colour resemblances between the *Heliconinæ* and *Ithomiinæ* had obscured in his mind the essential structural differences between these widely separated sub-families. (See Poulton, "Essays on Evolution," 1908, p. 327.)

In each of the four combinations hitherto considered, the *Ithomiinæ*, *Heliconinæ*, and *Nymphalidæ* are all represented. Combination IV alone contains no Pierine or Danaine member. On the other hand, it provides us with an *Acræa*, two *Satyrinæ*, a *Papilio*, and a Castniid moth. No species belonging to any of these groups enter the three other associations.

The possibility of a single warning pattern gradually changing in the passage from one locality to another, *e.g.* from the brilliant striped pattern of the Guatemala-Nicaraguan type to the more sombre colour of the Ecuador, Peru, and Bolivia type, becomes conceivable when we find transitional stages. Thus we may imagine that the North-Central American type is an ancestral dominant warning pattern, and that on proceeding towards the south-east, the conditions gradually began to favour a darker hind-wing, as in the Guianas, and a yellow band and apical fore-wing markings, as in Eastern Brazil. The favourable conditions here referred to include above all the influence of changes in the patterns of the most dominant and central models in the combinations. Following these great associations westward, the apparent differences between the Ega Combination (III) and those of the East and North, is found to be consistent with an underlying similarity. Thus we here recognise in the black band of the hind-wing and the yellow apical markings of the fore, the characters of the North-Central American Combination (I). I have already mentioned instances showing possible transitional stages between the Ega type and the still more westerly association in Ecuador, Peru, and Bolivia.

The whole problem, however, can only at present be one of surmise, owing to the enormous amount of work still to be done in these areas, and more especially in the intervening districts; for until far more data have been accumulated than at present, we can only indirectly infer that certain members of the associations are dominant as compared with others; and it is impossible to feel much confidence in the selection of any single pattern as the ancestral type which has given rise to those of adjacent areas. These questions must remain open until further labours have thrown far more light upon this fascinating subject.

CERTAIN MÜLLERIAN COMBINATIONS AMONG THE DANAINÆ OF THE OLD WORLD.

The accompanying Plate XXXIV exhibits members of three small associations from Southern India, Fiji and the Solomon Islands respectively. The names and localities are indicated on the plate itself, and, in greater detail, in the explanation of plate. The colours and patterns are those characteristic of an important Eastern section of the *Danainæ*—the *Euploëini*. In the two first-named localities, certain species of this section are seen to resemble one another: in the third locality a species (Fig. 10) of the other important section of the *Danainæ*—the *Danaini*—has assumed the superficial appearance of an Euploëine (Fig. 5). It is unnecessary to speak in any detail of the associations represented on Plate XXXIV: they are only introduced on the present occasion for the striking comparison which they afford with the New World Combinations exhibited on the four preceding plates. I may, however, remark upon the interesting example of Fijian mimicry in Figs. 4 and 9. It is here obvious, as Professor Poulton pointed out to me, that the chief spot in the fore-wing of *Derugena proserpina* (Fig. 9) has been lengthened inwards so as to afford a superficial resemblance to the chief spot of its model *Nipara eleutho* (Fig. 4). Although the two chief elements of the pattern in these two Euploëines have thus attained a considerable degree of resemblance, it is certain that they belong to a different series of white markings,—sub-marginal in the mimic (Fig. 9), discal in the model (Fig. 4).

In these Old World Combinations no *Ithomiinæ* lead

the way, and their place is taken by the highly distasteful *Danainæ*, so dominant in the Oriental and Ethiopian Regions. In the former, both *Danaini* and *Euplexini* (here alone shown as models) are dominant; in the latter, the *Danaini*. The examples figured on Plate XXXIV are valuable for comparison with those from the New World; for they prove that, with an entirely different superficial appearance, the same bionomic principles are equally prevalent in the tropics of both hemispheres. The *Danainæ* of the Old World represent and take the place of the *Ithomiinæ* in the New, and exhibit, although with very different colours and patterns, the same conspicuousness at rest and in flight, the same countless swarms of individuals, the same Müllerian resemblances between dominant species, and the same mimetic attraction for less abundant species of other groups.

APPENDIX.

Melinæa pardalis, Bates, n. sub-sp. *madeira*.

Melinæa madeira appears to be a MS. name of Staudinger's. Professor Poulton and Mr. F. A. Heron have very kindly spent much valuable time in an endeavour to trace a description of it, but without success. Thinking that the discrimination of this sub-species of *Melinæa pardalis*, Bates, may be a convenience to naturalists, a description is here added.

Melinæa madeira, n. sub-sp.

This sub-species differs from *M. pardalis*, Bates, in the following points on the upper side. *Fore-wing*: the thick black inner marginal border of *pardalis* (which is limited by the median nervure and first median nervule) is reduced to a narrow, superiorly somewhat diffuse, dark marginal edging in *madeira*. The large triangular black spots, one below the outer part of the cell and the other in the basal part of the cell itself, are reduced by more than half in *madeira*. Exterior to these spots in *madeira* are two yellow oblique angulated bands joined about the second median nervule; in *pardalis*, however, the inner one has become suffused with the mahogany ground colour (with the exception, in one example, of a

single yellow spot just under the sub-costal nervure). In the type of *madeira* (Fig. 2) the apical markings of the fore-wing of *pardalis* are nearly obliterated by a fuscous suffusion, but in another example at Oxford they persist almost as in the Ega form. The yellow spot at the anal angle in *madeira* is well developed, being larger than in *pardalis*. *Hind-wing*: the black bar across the hind-wing so strongly developed in *pardalis* is much reduced in *madeira*, and does not reach the inner margin. All its constituent markings in *madeira* are somewhat rounded and give a less continuous appearance than the compact bar and marginal border of *pardalis*. This latter is also greatly reduced, being much narrower and more completely divided into its constituent markings. On the under side the same points of difference occur as on the upper; although the black markings in the fore-wing of *pardalis* are here not quite so obviously heavier than those of *madeira*. A noticeable difference in the fore-wing is the appearance, along the hind-margin (above the anal spot), in *madeira* of four (in one specimen) small pale-yellow spots which are absent in *pardalis*. In the second specimen the spot nearest the apex is barely distinguishable.

Type ♀ in Hope Department, University Museum, Oxford (Plate XXXII, fig. 2).

Distribution, based on two ♀ specimens in Hope Department, with the general locality Amazons, and one ♂ and two ♀ in the British Museum from Manicoré, on the Rio Madeira, the most important southern tributary of the Amazon.

In another specimen of *M. pardalis*—probably taken higher up the Amazons in Northern Peru or Ecuador—a more chestnut-fulvous ground colour takes the place of the mahogany tint, and the sub-apical markings lose much of their yellow shade. The yellow spot at the anal angle of the fore-wing is still more obscured. The presence of this chestnut-fulvous colouring shows a transition into other Peruvian forms in which this change is carried still further.

H. W. Bates (Trans. Linn. Soc., Lond., 1862, vol. xxiii, part iii, p. 552) makes an interesting note on this very point. He writes: "I did not meet with *M. pardalis* at S. Paulo; but at Tabatinga, eighty miles further west, it again occurred, not however under precisely the same form as at Ega, but in a modified state, the yellow

cross-belt and the spot at the hind angle of the fore-wing having become of the same dark orange-brown hue as the rest of the wing. The same transformation of colour takes place in many species of *Heliconidæ* in travelling from east to west, and I am inclined to think it is due to the direct action of the physical conditions of the localities on the early states of the insects."

M. madeira must be considered a south-eastern form of *M. pardalis*, whose chief habitat is at Ega, on the Upper Amazons.

It should be observed that in this description two ♀ ♀ of *M. madeira* were compared with two ♂ ♂ of *M. pardalis*.

My sincere thanks are due to Mr. R. Trimen, F.R.S., for his kind help in the above description.

EXPLANATION OF PLATES XXX—XXXIV.

[See *Explanation facing the PLATES.*]



Alfred Robinson, phot.

All figures are $\frac{1}{2}$ of the natural size.

North Central American Ithomiine-centred Combination, with banded
"Melinæa" (Haase) pattern.

Guatemala to Nicaragua and Honduras.

EXPLANATION OF PLATE XXX.

North Central American Ithomiine-centred Combination with banded "*Melinæa*" (Haase) pattern. Guatemala, Honduras and Nicaragua.

All the figures are half of the natural size and represent the upper side unless otherwise stated.

ITHOMINÆ.

1. *Melinæa imitata*, Bates, ♂. Mirandilla (1700 ft.). Pacific Slope of Guatemala. Hope Collection.

2. *Melinæa imitata*, Bates, ♀ (under side). Zapote, Guatemala. Hope Collection.

3. *Mechanitis doryssus*, Bates, ♂. V. de Sta. Maria, Pacific Slope, Guatemala. Hope Collection.

4. *Mechanitis doryssus*, Bates, ♀. Guatemala, Atlantic Slope, Vera Paz, Cubilguitz. March 10th-20th, 1880. Hope Collection.

5. *Ceratinia dionæa*, Hew., ♀. Mirandilla (1700 ft.). Hope Collection.

6. *Ceratinia dionæa*, Hew., ♂. Zapote, Guatemala. Hope Collection.

7. *Ceratinia fenestella*, Hew., ♂. Chontales, Nicaragua. Hope Collection.

8. *Ceratinia fenestella*, Hew., ♀. Nicaragua. 1871. Hope Collection.

HELICONINÆ.

9. *Heliconius ismenius telchinia*, Dbld., Hew., ♂. Guatemala, Chiacaman, Vera Paz. Hope Collection.

10. *Heliconius ismenius telchinia*, Dbld., Hew., ♂ (under side). Guatemala, Chiacaman, Vera Paz. Hope Collection.

11. *Eueides cleobæa zorcaon*, Reak., ♂. Chontales, Nicaragua. Hope Collection.

12. *Eueides cleobæa zorcaon*, Reak., ♂. Nicaragua, 1871. Hope Collection.

DANAINÆ.

13. *Lycorea atergatis*, Dbld., Hew., ♂. Guatemala, Atlantic Slope, Vera Paz, Teleman. May 12th-18th, 1880. Hope Collection.

14. *Lycorea atergatis*, Dbld., Hew., ♂. Guatemala, Atlantic Slope, Vera Paz, Cubilguitz. March 10th-20th, 1880. Hope Collection.

Explanation of Plate XXX.

PIERINÆ.

15. *Perrhybris malenka*, Hew., ♂. Hope Collection.
16. *Perrhybris malenka*, Hew., ♀. Hope Collection.
17. *Dismorphia praxinæ*, Dbld., ♂. Guatemala (Central), S. Geronimo. August 10th, 1879–June 26th, 1880. Hope Collection.
18. *Dismorphia praxinæ*, Dbld., ♀. Chontales, Nicaragua. Hope Collection.

NYMPHALINÆ.

19. *Eresia philyra*, Hew., ♂. Guatemala, Chiacaman, Vera Paz. Hope Collection.
20. *Eresia philyra*, Hew., ♀. Guatemala, Chiacaman, Vera Paz. Hope Collection.
21. *Protoponius cecrops*, Dbld., Hew. Guatemala, Cahabon, Vera Paz. Godman-Salvin Collection.
22. *Protoponius cecrops*, Dbld., Hew. (under side). Pacific Slope, Guatemala. Godman-Salvin Collection.

EXPLANATION OF PLATE XXXI.

East Brazilian Ithomiine-centred Combination, characterised by yellow hind-wing band and white apical fore-wing marking.

All the figures are about two-thirds of the natural size, and represent the upper side, unless otherwise stated.

ITHOMIINÆ.

1. *Mechanitis lysimnia*, Fabr., ♂. Captured March 10th, 1826, by W. J. Burchell, at Rio de Janeiro. Hope Collection.

2. *Mechanitis lysimnia*, Fabr., ♀ (under side). Sao Paulo, S. Brazil. "Winter." Hope Collection.

3. *Ceratinia daeta*, Boisd., ♀. Miers Collection. From the neighbourhood of Rio. Hope Collection.

4. *Ceratinia daeta*, Boisd., ♀ (under side). Brazil. Hope Collection.

5. *Napeogenes euryanassa*, Feld., ♀. Rio. Hope Collection.

6. *Napeogenes euryanassa*, Feld., ♂ (under side). Rio. Collected by S. Youds. Hope Collection.

HELICONINÆ.

7. *Heliconius narcæa narcæa*, Godt., ♀. Petropolis, Brazil. Hope Collection.

8. *Heliconius narcæa narcæa*, Godt., ♂ (under side). Petropolis, Brazil. Hope Collection.

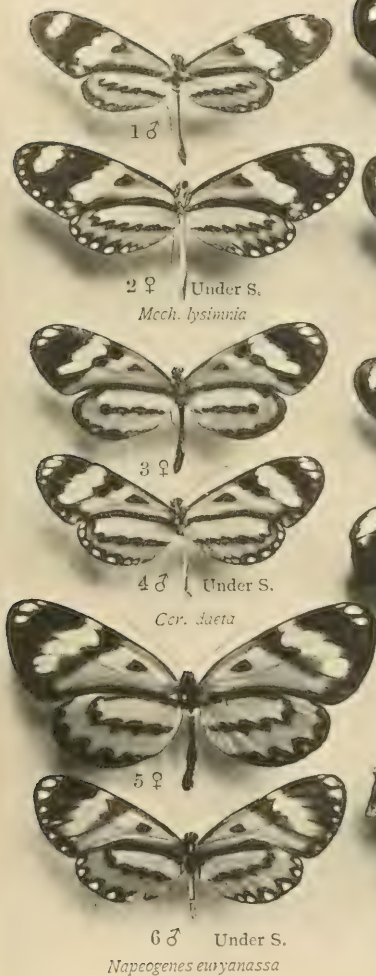
9. *Heliconius narcæa polychrous*, Feld., ♂. Captured August 29th, 1827 (a.m.), by W. J. Burchell, at Cervo, N. of Rio Pardo, Brazil. Hope Collection.

NYMPHALINÆ.

10. *Protogonius drurii*, Butl., ♂. Hope Collection.

11. *Protogonius drurii*, Butl., ♀ (under side). Hope Collection.

ITHOMIINÆ, 6.



HELICONINÆ, 3.



NYMPHALINÆ, 2.

Alfred Robinson, phot.

Andre & Sleigh, Ltd.

All figures are about $\frac{2}{3}$ of the natural size.

East Brazilian Ithomiine-centred Combination, characterised by yellow hind wing band and white apical fore wing marking.

EXPLANATION OF PLATE XXXII.

Upper Amazons (Ega) Ithomiine-centred Combination, characterised by a mahogany or chestnut suffusion, and the mottled appearance of the fore-wing.

All the figures are about two-thirds of the natural size, and represent the upper side, unless otherwise stated.

DANAINÆ.

1. *Lycorea cinnamomea*, Weymer. Upper Amazons, Manaos. Hope Collection.

ITHOMIINÆ.

2. *Melinæa pardalis*, Bates, sub-sp. nov. *madeira*, ♀. Amazons. Hope Collection. The figure represents the type of the female. This sub-species occurs on the Rio Madeira to the S.E. of Ega.

3. *Melinæa pardalis*, Bates, ♂ (under side). Hope Collection.

4. *Mechanitis egaensis*, Bates, ♂. Amazons, Bates, 1860. Hope Collection.

5. *Mechanitis egaensis*, Bates, ♀. Hope Collection.

PIERINÆ.

6. *Dismorphia egaëna*, Bates, ♂. Ega, H. W. Bates. Godman-Salvin Collection.

7. *Dismorphia egaëna*, Bates, ♀. Lower Napo, H. W. Bates. Godman-Salvin Collection.

HELICONINÆ.

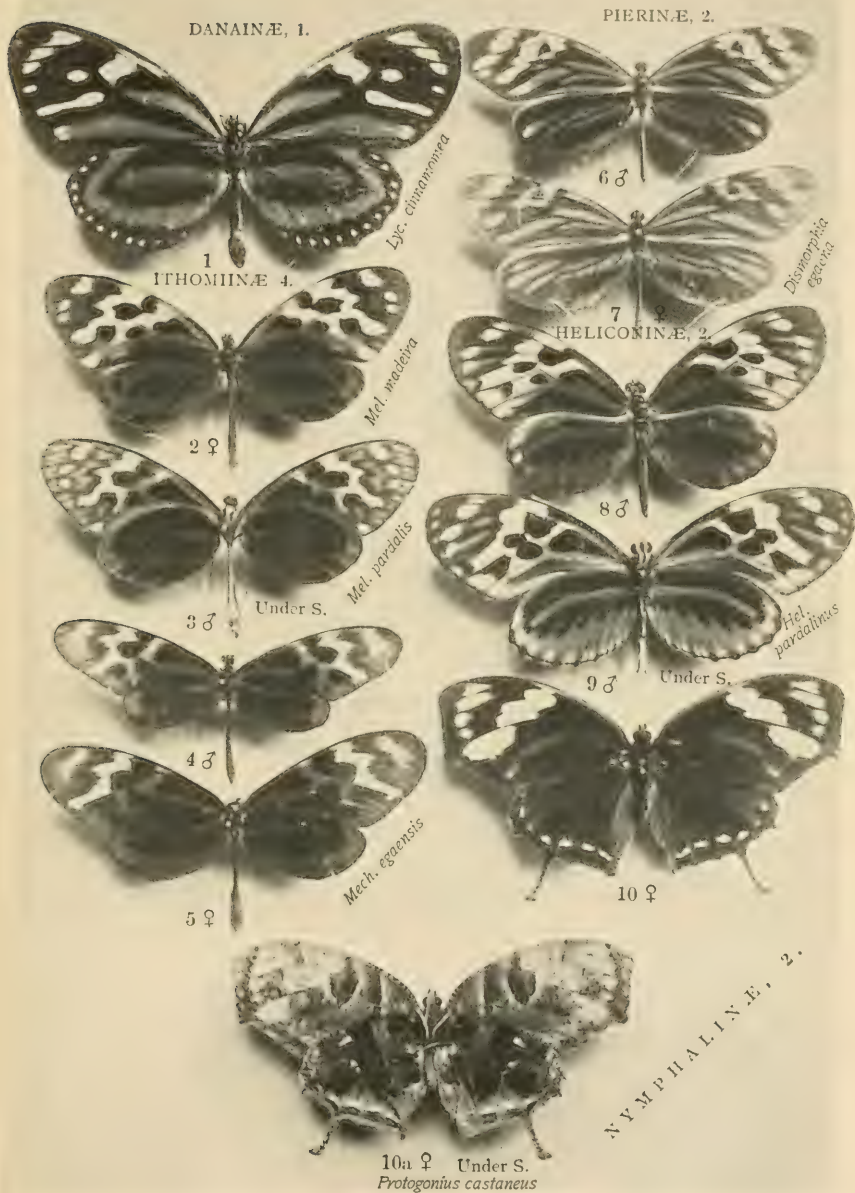
8. *Heliconius pardalinus pardalinus*, Bates, ♂. Hope Collection.

9. *Heliconius pardalinus pardalinus*, Bates, ♂ (under side). Manaos, Amazons. 1876. Godman-Salvin Collection.

NYMPHALINÆ.

10. *Protogonius castaneus*, Butl., ♀. Ega, H. W. Bates. Godman-Salvin Collection.

10a. *Protogonius castaneus*, Butl., ♀. Under side of Fig. 10.



Alfred Robinson, phot.

Andre & Sleigh, Ltd.

All figures are about $\frac{2}{3}$ of the natural size.

Upper Amazons (Ega) Ithomiine-centred Combination, characterised by a mahogany or chestnut suffusion and by the mottled appearance of the fore wing.



Alfred Robinson, phot.

All figures are $\frac{1}{2}$ of the natural size.

Andre & Sleigh, Ltd.

Ecuador, Peru and Bolivia Combination, characterised by orange-tawny markings on a black ground.

EXPLANATION OF PLATE XXXIII.

Ecuador, Peru and Bolivia Combination, characterised by orange-tawny markings on a black ground.

All the figures are half of the natural size, and represent the upper side, unless otherwise stated.

ITHOMINÆ.

1. *Melinæa mothone*, Hew., ♂. Peru. Hope Collection.
2. *Melinæa mothone*, Hew., ♀ (under side). N. Peru. Hope Collection.
3. *Hyposcada fallax*, Staud., ♀. Peru. Hope Collection.
4. *Mechanitis deceptus*, Butl., ♂. Ecuador. From collection of W. W. Saunders, 1830-73. Hope Collection.
5. *Mechanitis deceptus*, Butl., ♀. Ecuador, 1870. Higgins. Hope Collection.

HELICONINÆ.

6. *Heliconius aristiona aristiona*, Hew., ♂. Chairó, Bolivia. C. Buckley (Druce Collection). Godman-Salvin Collection.
7. *Heliconius aristiona aristiona*, Hew., ♂ (under side). Río Juntas, Bolivia, 3000 ft. (Garlepp). Godman-Salvin Collection.
8. *Eueides acacetes*, Hew. Peru (Druce Collection). Godman-Salvin Collection.
9. *Eueides acacetes*, Hew. (under side). Bolivia. C. Buckley, Godman-Salvin Collection.

ACRÆINÆ.

10. *Actinote acipha*, Hew., ♂. Río Verdi, Ecuador. C. Buckley. Godman-Salvin Collection.
11. *Actinote acipha*, Hew., ♀. Esmeraldas, Ecuador. Lehmann. Godman-Salvin Collection.

NYMPHALINÆ.

12. *Eresia ithomiola*, Salv., ♀. Aguana, Ecuador. Simson. Godman-Salvin Collection.
13. *Eresia ithomiola*, Salv., ♀. Cururai, Ecuador. C. Buckley (Druce Collection). Godman-Salvin Collection.
14. *Protogoniüs semifulvus*, Butl., ♂. Hope Collection.
15. *Protogoniüs semifulvus*, Butl., ♂ (under side). Hope Collection.

PAPILIONINÆ.

16. *Papilio bachus bachus*, Feld., ♂. S. Ecuador. Godman-Salvin Collection.

Explanation of Plate XXXIII.

17. *Papilio bachus bachus*, Feld., ♂ (under side). Peru (Kaden Collection). Godman-Salvin Collection.

HETEROCERA (HYPSIDÆ).

18. *Pericopis hydra*, Butl., ♀. Hope Collection.

19. *Pericopis hydra*, Butl., ♂ (under side). Ecuador. The figure represents the type of the species. Hope Collection.

EXPLANATION OF PLATE XXXIV.

Müllerian (Synaposematic) Combinations among Old World *Danainæ*,—chiefly *Euplœini*. The patterns are characteristically Euplœine.

All the figures are about three-fifths of the natural size, and represent the upper side.

EUPLÆINI.

1. *Narmada coreoides*, Moore, ♂. Utakamand, Nilgiris (7500 ft.) April 14th, 1896. A. G. Cardew. Hope Collection.

2. *Crastia core*, Cram., ♂. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

3. *Pademima kollari*, Feld., ♂. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

4. *Nipara eleutho*, Quoy. = *eschsoltzii*, Feld., ♂. Fiji, Viti Levu, S. of mouth of Rewa River, Coral Island, near Nukulau. October 15th, 1897. Gustav Gilson. Hope Collection.

5. *Euplœa asyllus*, Godm. and Salv., ♀. Fauro Island, Solomon Islands. End of August and early September, 1886. C. M. Woodford. Hope Collection.

6. *Narmada coreoides*, Moore, ♀. Bombay. Hope Collection.

7. *Crastia core*, Cram., ♀. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

8. *Pademima kollari*, Feld., ♀. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

9. *Deragena proserpina*, Butl., ♂. Fiji, Viti Levu, S. of mouth of Rewa River, Coral Island, near Nukulau. October 15th, 1897. Gustav Gilson. Hope Collection.

DANAINI.

10. *Salatura decipiens*, Butl., ♀. Fauro Island, Solomon Islands. End of August and early September, 1886. C. M. Woodford. Hope Collection.

EUPLOEINI.



SOUTH INDIA.



FIJI ISLANDS.



FAURO, SOLOMON ISLES.

Alfred Robinson, phot.

Andre & Sleigh, Ltd.

All figures are about $\frac{3}{4}$ of the natural size.

Müllerian (Synaposematic) Combinations among Old World Danainæ,— chiefly Euploëini. The patterns are characteristically Euploëine.

XXV. *Bionomic Notes on Butterflies.* By G. B. LONGSTAFF,
M.A., M.D., F.E.S.

[Read October 7th, 1908.]

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Introductory.

WHEN travelling in a country new to him it is almost inevitable that an entomologist's time should be chiefly taken up with searching for insects and securing specimens—his temptation is to become "a mere collector." Further, such observations of more scientific value as he finds time to make are but too apt to be isolated, imperfect and inconclusive. Yet something may be done even during a flying visit, and a judicious arrangement of the notes made may provide useful material for further work by the same naturalist, or by a more capable or more fortunately circumstanced observer, following his footsteps.

But it may be objected to such a paper as this, that it is made up of trivial details, that it is loaded with wearisome repetitions, that everybody has long been familiar with the facts brought forward—in short, that it is but a laborious "demonstration of the obvious."* So be it. For the sake of argument these propositions might all be admitted, and yet the time spent in writing the paper, and

* *W. Bateson*, F.R.S., Report of British Association, 1904, p. 577.

even the space occupied by it in the "Transactions" be amply justified.

The immortal work of Lyell, of Darwin and of Wallace was largely built upon seeming trivialities, on facts many of which were "obvious," and therefore to some persons uninteresting. But with what different eyes do we now look upon those same facts, filled as they are with new meaning! Surely present-day naturalists cannot do better than follow humbly in the footsteps of those "old masters"—observe, record and arrange facts—extract and dress the ore ready for some future metallurgist to smelt, so that some future smith may have the wherewithal to forge useful tools or works of art.

Far more experienced observers than the writer have unfortunately lacked the time or the inclination to place their facts on record. Indeed it is one of the saddest things in the history of science that so much knowledge has perished with the gleaners.* Again, though the facts may have been recorded it is surely well that they should be confirmed, even time after time, before hasty inferences are drawn. Yet again, it is surely desirable to find out how far the facts extend, to what species, genera, families; to what degree they are developed; whether they vary in the two sexes, in the individual, the species, the genus; how they are distributed in space and time and season. Lastly, it is just possible that here and there a seemingly small fact, a residual phenomenon of real import, may have hitherto escaped observation, or at any rate may not have been recorded.

With this apology the following somewhat disjointed notes are communicated, notes on observations made for the most part in the West Indies or Ceylon, but some in other lands and some in Devonshire. Previously recorded kindred observations of the author's are referred to in foot-notes, and occasionally quoted in full, with a view to focussing, as it were, all the scattered facts, in the hope of illuminating even to a small degree sundry holes and corners in the great mystery of evolution.

§ 1. *Scents.*

It is now four years since Dr. F. A. Dixey drew atten-

* Col. C. T. Bingham's diaries were in my mind when writing this; he died the week after the paper was read!

tion to the scents of certain common British butterflies.* Since then, dealing with South African material, he has confirmed Fritz Müller's important generalisation,† that these scents may be divided into two classes:—(1) those which are presumably attractive, and are found (with few exceptions) in the male insect only; and (2) those which are presumably repulsive, or protective, and are (with very few exceptions) common to both sexes, often strongest in the female. Further, Dr. Dixey has called attention to the fact that the scents of the first class are agreeable to the average human perception, while those of the second class are for the most part disagreeable, or even disgusting.‡

The additional facts that I am now able to supply appear to confirm previous generalisations, though there are a few apparent exceptions which require further elucidation.

One point may here be mentioned. In addition to the scents hereafter dealt with, a "mousy odour" is in several cases recorded; this is not confined to one sex and is met with in butterflies belonging to various families, but only *after death*. This I believe to be a product of decomposition of either the animal juices or the fæces. The odour resembles that of acetamide, and not improbably may be due to that substance, or some compound ammonia.

It will be noticed that in but very few cases have I concerned myself with the special organs which are involved in elaborating or distributing the scents. Moreover, the subject is now so familiar and the number of species known to produce scents perceptible to man is now so large, that it does not seem necessary to give the new evidence in great detail, nor (as a rule) to deal with species in which positive results have not yet been clearly established.

In the present state of our knowledge it seems most convenient to deal with the various species observed in the order of their systematic arrangement in our cabinets.

* Dixey, Proc. Ent. Soc. Lond., 1904, pp. lvi-lx.

† Fritz Müller, Trans. Ent. Soc. Lond., 1878, pp. 211-221.

‡ Dixey, Proc. Ent. Soc. Lond., 1905, pp. liv-lix; *ibid.* 1906, pp. ii-vii. See also Wood-Mason and De Nicéville, Journ. Asiatic Soc. Bengal, 1886, vol. xv, Part II, No. 4, pp. 343-393. See also Longstaff, Ent. Month. Mag. 1905, pp. 112-115; do. Proc. Ent. Soc. Lond. 1905, pp. xxxv-xxxvi; do. Trans. Ent. Soc. Lond., 1905, pp. 137-8.

So far, however, as the facts are available it would appear that, speaking generally, the *Pierinæ* and *Satyrinæ* belong to the first class, or those with attractive scents, whereas the *Danainæ*, *Acraeinæ* and *Heliconiinae* belong to the second, or those with repulsive scents. The *Ithomiinæ*, *Nymphalinae*, *Lycanidæ* and *Papilioninae* contribute to both classes. Of other groups little or nothing is known as regards scents.

NYMPHALIDÆ.

ITHOMIINÆ.

Tithorea megara, Godt. (Trinidad, 1907). Three ♂ had a very distinct, or even strong, scent, which was compared by both Mrs. Longstaff and myself to *Stephanotis*, but I thought that it had in addition a spicy, or dusty element. A ♀ was scentless.

Athesis clearista, Dbl. (Venezuela, 1907). A ♂ had a slight sweet flowery scent, both alive and dead: it appeared to be associated with the brushes on the hind-wings.

Leucothyris victorina, Hew., and *L. phemone*, Dbl. (Venezuela, 1907). A ♂ of each of these species had an offensive odour, which in the latter case seemed to be associated with the tufts or brushes on the hind-wings.

DANAINÆ.

Anosia archippus, Fabr. (Jamaica, Tobago, Panama, Venezuela, 1907). 15 ♂, 2 ♀. All had a scent, similar in quality and intensity in both sexes; it is described in my notes as "slight," "moderate," or "strong," and is compared to that of a cockroach, a musk-rat, a rabbit-hutch, or musty dung; in two cases it is qualified as "scarcely unpleasant," and "scarcely disagreeable."

Danaida plexippus, Linn., *genutia*, Cram. (Mátherán, Bombay Presidency, 1908). A ♂ had a slight "musk-rat" odour in the field, none at home though still alive.*

Danaida jamaicensis, Bates (Jamaica, 1907). 2 ♂, 2 ♀. Of the two males the scent is described respectively as "strong rabbit-hutch odour," and "decided odour, ? cockroach, scarcely disagreeable." Of the females it is noted "both with a strong cockroach smell, perceptible next day: my wife, however, described the odour as slightly fusty."

* Compare Longstaff, Trans. Ent. Soc. Lond., 1905, p. 138.

Danaida eresimus, Cramer (Colombia, Venezuela, 1907). Of 2 ♂ it is noted "very slight pleasant scent"; of a ♀ "strong, ?musk-rat odour when alive."

Tirumala septentrionis, Butl. (Ceylon, 1908). 11 ♂ were examined, 9 of them yielded a scent, noted as "slight," "moderate," or "decided," and described as pleasant or sweet, and in two cases compared (with, however, some hesitation) to clover. In four instances the genital tufts were displayed; certainly in one of these no scent was perceptible (though subsequently detected in the house). In another instance it is noted that the scent was not connected with the "sexual pouch" on the hind-wing.

Seven ♀ were examined: in 6 the result was negative or doubtful; in the other a slight scent was found and compared in the field to *Stephanotis*, but Mrs. Longstaff in the house said "? ginger."

This species is exceptional among *Danainae*,* having a decidedly agreeable scent, strongest in the ♂.

Danaida chrysippus, Linn. (Ceylon, 1908). Of 2 ♂ one was without scent, in the other the "musk-rat odour" was detected both during life and after death. In 2 ♀ the musk-rat odour was detected in the field but noted as especially strong at home.†

Chittira fumata, Butl., *taprobana*, Feld. (Ceylon, 1908). Out of 4 ♂ and 4 ♀ a scent was noted in 2 of the latter only, described in the field as "a slight musty scent," but on re-examination in the hotel compared to stale tobacco-smoke. In 1904 the results obtained were more positive—"it has the 'acetylene' odour of *Crastia core*, but not so strong and with a difference."‡

Parantica aglea, Cram., *ceylanica*, Feld. (Ceylon, 1908). A distinct scent was detected in 15 ♂ out of 17, and in 11 ♀ out of 14. In the ♂ the scent varied from "very slight" to "strong," twice indeed it was so strong as to be clearly perceptible when the insect was fluttering in the net. In quality it was in 13 cases compared to acetylene (it being specially noted in one instance as "*not Hamamelis*"); in the other 2 specimens it is described as "acetylene *plus* cockroach," but these when re-examined in the house were described as "cockroach only," and

* Compare Bingham, "Fauna of British India: Butterflies," vol. i, p. 2.

† Cf. *Dixey*, Proc. Ent. Soc. Lond., 1906, p. iv.

‡ Longstaff, Trans. Ent. Soc. Lond., 1905, p. 131.

"slightly musty" respectively. In 6 cases in which there was a decided, or even strong, scent in the field, none was detected in the house; in other instances the scent at home was slighter, or even described as "musty," but in one specimen it was compared to sweet hay.

In all the 11 ♀ the scent is compared to acetylene, with the remark in one case "not so pungent as *Euploea asela*." Two other ♀ specimens were said to have a musty odour.

I am satisfied that in the case of *P. aglea* the scent is more transitory, possibly more volatile, than in the majority of scent-yielding butterflies.

Crastia asela, Moore (Ceylon, 1908). In 32 out of 38 ♂ and in 17 out of 19 ♀ examined a scent was noted in the field. In 4 ♂ and 1 ♀ my notes record that no scent was detected, as regards the others they are silent. Again, it is clearly recorded that on re-examination in the hotel in the case of 13 ♂ and 5 ♀ no scent could be detected, moreover when a scent *was* noted at home it was in the large majority of cases (especially among males) much fainter than it had been in the field.

In both sexes the scent varied considerably in strength: it was I think quite as strong in the females as in the males, though certainly the three instances in which the scent was strong enough to be obvious through the net were all males. In one ♂ the scent was described as "not unpleasant"; in 5 instances—1 ♂, 4 ♀—it is described as pungent and compared to acetic acid. In the case of a ♀ the note is: "strong pungent odour, acetic acid: distinct at home, still pungent (insect alive). The scent adhered to the fingers after pinching."

As in the case of *Parantica* the scent of *Crastia* would appear to be more volatile than in the *Pierinae* or in *Limnas*.

Having abundant material I made some endeavour to ascertain the source of the scent. In 15 cases it is noted that the ♂ genital tufts were fully everted when the insect was examined, nevertheless in 5 no scent could be detected, although in the others it was more or less strong. There is a special note in one case: "the acetylene odour seemed to come from the tufts," but, on the other hand, in 4 cases it is noted that the scent appeared to come from the wings, in one of these from their upper surface.

I then tried the effect of rapid dismemberment immediately after pinching:—

(a) A ♂ seen on the wing with tufts displayed. It was caught, pinched and the abdomen amputated. The abdomen yielded no scent, but what I may term the *torso* had a slight acetylene scent, which appeared to come from the wings.

(b) A ♂ with the tufts displayed; the amputated abdomen yielded no scent, but the wings a moderate "acetylene" scent.

(c) A ♂ with the acetylene scent: amputation proved that it was certainly not connected with the abdomen.

(d) A ♂ was dismembered: the scent appeared to come from the thorax.

(e) A ♀ with pungent odour was dismembered: the scent appeared to originate in the thorax.

(f) A ♀ was dismembered: the scent appeared to come from either the thorax or the base of the wings.

From these facts I am forced to the conclusion that in *Crastia* and in *Tirumala* the scent—which moreover is common to both sexes—whatever its source may be, is independent of the genital tufts which form such a conspicuous feature. This conclusion is contrary to my first impression—and certainly contrary to the impressions of such an experienced collector as Commander J. J. Walker, R.N.*

Pademna sinhala, Moore (Ceylon, 1908). Two ♂ were examined with the following results:—

(a) Acetylene odour, moderate in the field, slight at home. (b) Moderate acetylene scent in the field, none in the house. It was alive; on pinching it again the tufts were protruded and there was a momentary strong acetylene scent. Of course it does not necessarily follow that the scent emanated from the tufts.

Narmada montana, Feld. (Ceylon, 1908). 5 ♂ all had a strong, or at any rate decided, acetylene odour in the field; at home either no scent at all, or at most a faint musty odour. In one case the strong acetylene odour seemed to come from the upper surface of the body or wings, while there was a suspicion of a sweet scent (compared with some hesitation to sassafras) which

* Compare *Wood-Mason*, Journ. Asiat. Soc. Bengal, 1886, pp. 343-393, quoted by *Dr. Dixey*, Proc. Ent. Soc. Lond., 1906, p. vi. See also *Longstaff*, Trans. Ent. Soc. Lond., 1905, pp. 87, 108.

seemed to come from the tufts. A living ♀ yielded an odour of acetic acid, which persisted slightly after death.

SATYRINÆ.

Calisto zangis, Fabr. (Jamaica, 1907). In 10 ♂, nearly all those examined, there was a scent varying from faint to strong, compared to treacle, chocolate, burnt sugar, or caramel, but in one instance described simply as "aromatic." The ♂ of this species has a very conspicuous brand. Ten ♀ were without scent.

Mycalasis mineus, Linn., f. *polydecta*, Cram. (Ceylon, 1908). In 2 ♂ exposure of the pencils of hairs on the hind-wings produced a strong scent, which I compared to burnt sugar, my wife to "coarse brown sugar," or "treacle."

Ypthima ceylonica, Hew. (Ceylon, 1908). In a few ♂ of this abundant species a very slight scent of chocolate was detected.

ELYMNINÆ.

Elymnias fraterna, Butl., *undularis*, Dru. (Ceylon, 1908). Four ♂ had an odour resembling that of vanilla-scented chocolate: in one case Mrs. Longstaff compared it to "very strong honey, or coarse brown sugar."

NYMPHALINÆ.

Neptis jumba, Moore (Ceylon, 1908). A faint sweet chocolate scent was detected in a male in the house. A somewhat similar scent was suspected in another male and in a female. On the other hand, no scent was recognised in the much commoner *N. varmona*, Moore.*

Victorina stelenes, Linn. (Jamaica, 1907). Five ♂ appeared to have a slight flowery scent, in one instance suggesting chrysanthemum.

Precis iphita, Cram. (Ceylon, 1908). Two ♂ out of several examined yielded a slight treacly odour. I noted a similar scent in *P. clelia*, Cram., in S. Africa in 1905.†

Cynthia asela, Moore (Ceylon, 1908). Five ♂ out of 8 had a peculiar slight sweet scent, compared at the time to sassafras, or to French-polish.‡

* Compare Dr. Dixey's results with African species of the genus. Proc. Ent. Soc. Lond., 1906, p. v.

† *Ibid.* p. v.

Dione vanillæ, Linn. (Jamaica, 1907). Of 17 ♂ examined 13 exhibited an odour varying from very faint to very strong: in character this was distinctly disagreeable, and I noted it as "unpleasant," "like cowdung," or "like asses," but more usually as "like a stable." My wife considered it "unpleasant," or "offensive." Mr. Abell thought it "musky." A single ♂ of the nearly allied *D. juno*, Cram. (Venezuela, 1907), had a slight stable-like odour.

Colænis cillene, Cram. (Jamaica, 1907). In 8 ♂ out of 11 examined there was a scent, decided, but in no case strong. Its character was noted as "peculiar," "sweetish," "pleasant," "distinctly aromatic," "resinous," "drug-like," or "medicinal"; it suggested to me at one time or another tar, Canada-balsam and *pure* carbolic acid, but my wife compared it to ginger, or a mixture of ginger with jasmine. It is evident that this scent puzzled me greatly at the time, but subsequent experience with other scents makes me think that sassafras would probably be the best comparison.

HELICONIINÆ.

Heliconius euryades, Riff. (Trinidad, 1907). Two ♂ were examined; one had a peculiar, rather pleasant, smell, the other none. Two ♀ were also examined, one with a doubtful result, the other had a slight odour like that of the species next mentioned, but it was only perceptible during life.

Heliconius hydarus, Hew. (Trinidad, Tobago, Venezuela, 1907). Eleven ♂ were examined: 3 gave a negative result and 1 was doubtful, but the remaining 7 had a scent which varied from "very slight" to "very strong," and was described as "musty," "like acetylene," or "like hazeline" (*Hamamelis virginica*, Witch-hazel). This last comparison, which struck me as very good, is due to Mr. G. H. Swarder of Cocoa Wattie, Tobago, who was quite familiar with the scent of the butterfly. Eight ♀ were examined, only 1 with negative results; in the other 7 the scent varied from slight to strong, and was described as "disagreeable," "like acetylene," or "like hazeline." In the case of 1 ♂ and 1 ♀ the scent was so strong as to be easily discerned when the butterfly was fluttering in the net.

Five of the above butterflies were captured in Trinidad

on 14 April, 1907, and were examined for scent when their enclosing papers were opened at Oxford on May 6th, or three weeks after death. One of them—*H. euryades*, ♀—had no scent; the others—*H. hydamus*, 3 ♂, 1 ♀—had a slight, but quite decided, scent! Yet, curiously enough, in the case of two of these male *hydamus*, I did not find it possible on the day of capture to be sure that they had any perceptible scent. Finally, when a drawer containing all my black and red *Heliconii* was opened on 15 July, or three months after death, the odour, though faint and evanescent, was distinctly perceptible in spite of the presence of naphthalene!

I have since heard from a professional setter that he had often noticed when setting them that *Heliconii* had a peculiar scent.

Heliconius charithonia, Linn. (Jamaica, 1907). With this species the majority of observations gave negative results, nevertheless in 3 ♂ and 2 ♀ a slight pleasant flowery scent was detected. In one example of each sex this was confirmed by my wife, who described the odour as "sweet."

Euclides aliphera, Godt. (Trinidad, 1907). Three ♂ were examined, 2 with a negative result; the third was noted as having "a strong *Dione* scent," *i. e.* an odour like that of a stable, or of asses. Two ♀ were also examined; they both had decided odours described respectively as:—"peculiar scent, ? acetylene; strong when alive," and as "strong *Dione* scent when living; slight flowery scent when dead."

LYCÆNIDÆ.

Cyaniris singalensis, Felder (Ceylon, 1908). Six out of 8 ♂ had a scent of varying intensity, described in all cases as sweet, once as "luscious," and once as "*Preesia*-like."

Nacaduba atrata, Horsf. (Ceylon, 1908). Two ♂ had a sweet flowery scent, confirmed by Mrs. Longstaff, and in one case compared by her to "very, very faint jasmine."

Lampides elpis, Godt. (Ceylon, 1908). Five ♂, all those examined, had a sweet scent, which in one instance was compared (with some hesitation) to clover.

Lampides lactata, De Nicéy. (Ceylon, 1908). Nine ♂ were examined, all had a distinct smell which was compared to vanilla biscuits, or chocolate sweets.

Lampides celeno, Cram. (Ceylon, 1908). A minority of the numerous ♂ examined had a faint sweet scent.

Catochrysops hanna, Stoll. (Jamaica, Trinidad, Tobago, Colombia, Panama, Venezuela, 1907). One ♂ was noted to have a very strong, sweet, *Freesia*-like scent, but most of my specimens of this tiny butterfly appeared to be odourless.

Polyommatus bæticus, Linn. (Ceylon, 1908). About half of the ♂ examined had a slight scent like that of meadow-sweet.

Polynippe dumenilii, Godt. (Venezuela, 1907). Ten ♂ of this little black-and-white butterfly gave positive results of a surprising character. In the majority of cases the odour was strong, or even very strong; moreover it was disagreeable; and I compared it to horse-urine, but more usually to pig-styes, or, perhaps more correctly, to pigs! At first it seemed scarcely credible that so small a butterfly could smell so strongly. My only ♀ specimen was odourless.

Rapala lazulina, Moore (Ceylon, 1908). Three males yielded a scent like vanilla biscuits.

Theclopsis tephraeus, Hübn. (Venezuela, 1907). A strong, peculiar, rather disagreeable odour was detected in a ♂ of this species.

Tmolus cambes, Godm. and Salv. (Venezuela, 1907). I noted in a ♂ a "treacly smell"; Mrs. Longstaff compared it to "coarse brown sugar."

Tmolus palegon, Cram. (Venezuela, 1907). A ♂ had an odour of chocolate.

PAPILIONIDÆ.

PIERINÆ.

Enantia melite, Clerck (Venezuela, 1907). The only specimen taken, a ♂, had a scent like mignonette.

Terias euterpe, Mén. (Jamaica, 1907). I had ample opportunities of studying this very common Jamaican butterfly. Of 21 ♀ taken not one was scented, but 31 out of 39 ♂ indubitably were. Their odour varied from "very slight" to "strong" (17 specimens); my wife described it on various occasions as "a slight pleasant smell," "strong, like syringa," "a very soft gentle smell, might be jasmine," and "very slight, sweet, jasmine or syringa." Mr. A. P. Ponsonby who walked with me one day suggested "gorse."

To my own judgment the scent resembled rather clove-pink, but was still more like pink bind-weed (*Convolvulus arvensis*, Linn.).

Terias delia, Cram. (Jamaica, Panama, Colombia, Venezuela, 1907), and *T. phiale*, Cram. (Venezuela, 1907). Results conflicting, but in the large majority of cases negative.

Terias albula, Cram. (Trinidad, Tobago, Colombia, Venezuela, 1907). Results uniformly negative.

Terias nise, Cram. (Trinidad, Tobago, Panama, Venezuela, 1907). Out of 8 ♂ taken 5 had a scent, varying from very slight to very strong; it was compared to that of pink bind-weed. A slight scent was detected in a ♀ specimen, this was confirmed by Mrs. Longstaff.

Terias messalina, Fabr. (Jamaica, 1907). In 6 ♂ out of 10 a scent was noted; it is described in my notes as "distinct" or "strong," and compared to pink bind-weed and to spice. It is also noted as "distinct from that of *euterpe*, more dusty, less specific," but another specimen "more spicy than bind-weed."

Terias westwoodii, Boisd. (Jamaica, 1907). Only 3 ♂ were taken, all had a scent, described in one case as "spice odour, not quite the same as *euterpe*."

Terias libythea, Fabr. (Ceylon, 1908). In several ♂ specimens—at least five—a faint scent was detected, which I compared to that of *Convolvulus arvensis*.

Terias hecabe, Linn. (Ceylon, 1908). I failed to detect any scent in this common *Terias* or any of its allied forms.

Catophaga paulina, Cram. (Ceylon, 1908). The results of my 1904 observations* were only in part confirmed. In both years the scent was noted in the ♂ only, in 1904 it was described as "like sweet briar, but sweeter and more luscious," whereas in 1908 it was variously described as "sweet," "very sweet, ? *Freesia*," "flowery," "decided Meadow-sweet," "decided *Stephanotis*," "extremely sweet."

Huphina nerissa, Fabr. (Ceylon, 1908). The results of Indian observations† of 1904 were confirmed, many ♂ yielding a distinct sweet-briar scent.

Pieris calydonia, Boisd. (Venezuela, 1907). Three ♂ of this species—all that I captured—had a distinct flowery

* Trans. Ent. Soc. Lond., 1905, pp. 128, 130.

† Loc. cit. pp. 66, 91, 101, 102, 120, 127.

scent, in one case described as "like that of *G. brassicæ*," in another as "somewhat sickly."

Pieris sp.—apparently undescribed—near *sevata*, Feld. (Venezuela, 1907). The only specimen taken, a ♂, had a "faint, sweet, flowery scent."

Leptophobia aripa, Boisd. (Venezuela, 1907). Seven ♂ out of 8 examined, had a distinct or even strong scent, which I compared on various occasions to orange, *Freesia* and mignonette.

Delias eucharis, Drury (Ceylon, 1908). In India during the winter of 1903–4 I observed the scent of this species and compared it to that of *Ganoris rapæ*, or sweet-briar. On that occasion I made sure of the scent in the ♂, and more than suspected its presence in the ♀.*

My more recent experience enables me to speak with greater confidence. Of 18 ♂ examined a scent was detected in 17; in 4 of these the scent was very slight, or indefinable, but in 12 it was strong, or very strong, and compared to that of sweet-briar. Out of 9 ♀ examined in 3 no scent could be detected, but in 6 specimens there was more or less scent, but in no case was it strong; this was described as "sweet," "dusty or musky," and "faint sweet-briar." Mrs. Longstaff said of the last specimen "very slight lemon-verbena; yes, perhaps more like sweet-briar"; but of another specimen she said "it has a little gentle sort of smell, ? ginger, or ? coarse brown sugar."

Daptonoura lycimnia, Cram. (Venezuela, Trinidad, 1907). The 3 ♂ taken all had a strong, sweet, flowery scent, suggesting *Freesia*. Of 3 ♀ one bears the note "rich sweet scent." There is no doubt whatever about the sex of the individual, neither can I suggest by way of explanation that the note really applies to another individual. This is perhaps the most marked of a very few exceptional cases in which a strong agreeable scent has been observed by me in a female Pierine; for some time my own view was that in each such instance I had been deceived—possibly by a neighbouring flower, or by the scent of another butterfly adhering to fingers or forceps. However, in the case of *D. lycimnia* Fritz Müller observed that the ♀ during courting emitted from her genitalia an odour which he described as "rather faint, though quite distinct . . . very different from that emitted by the wings of the male."

* Trans. Ent. Soc. Lond., 1905, pp. 87, 91, 101.

Fritz Müller found the latter "rather faint and often hardly distinguishable."*

Nepheronia ceylanica, Feld. (Ceylon, 1908). The ♂ of this beautiful butterfly has a more or less distinct scent, which I compared to *Freesia*. A ♀ had a similar scent, though slight, which my wife compared to frangipani.

Phæbis agarithe, Boisd. (Tobago, 1907). Of 3 ♂ examined two yielded a scent noted as being "sweet, neither strong nor pleasant."

Callidryas cubule, Linn. (West Indies, Northern coast of S. America, 1907). In no less than 32 out of the 33 ♂ tested a distinct scent was readily perceived, indeed in the great majority of cases it is noted as "strong," twice as "very strong." In quality the scent was agreeable (Mr. Abell termed it "delicious") and was compared to *Stephanotis*, or *Freesia*, but Fritz Müller† termed it musk-like; Miss Murtfeldt "slight violet,"‡ With the 22 ♀ examined the result was very different; in 9 cases it was negative, but in the remaining 13 a scent was detected, which, though usually described as "very slight," or "slight," and never as "strong," was often distinct enough. In quality the scent of the ♀ *cubule* was disagreeable; somewhat sweet, but recalling bad pomade, or rancid butter, or butyric acid (as Dr. Dixey aptly suggested of another butterfly). Fritz Müller described it as "a very strong peculiar odour, in which some volatile acid seemed to predominate."

Catopsilia pomona, Fabr. (Ceylon, 1908). The sweet scent associated with the fringes of the ♂ was confirmed:§ this I compared to *Freesia*, or *Stephanotis*. Out of 27 ♀ examined the result was negative in 18, but in the other 9 a slight, usually very slight, sweet scent without other special character was noted.

Catopsilia pyranthe, Linn. (Ceylon, 1908). The number of specimens taken was very much smaller than of *pomona*, but the scent was more easily detected in the ♂, and more decided in the ♀ than in that species.|| In both

* Fritz Müller, Trans. Ent. Soc. Lond., 1878, pp. 217, 218.

† Loc. cit. p. 218.

‡ Scudder, "Butterflies of the Eastern United States," vol. ii, p. 1047.

§ Trans. Ent. Soc. Lond., 1905, pp. 121, 122.

|| For previous experience compare Trans. Ent. Soc. Lond., 1905, pp. 101, 109, 118.

sexes the scent was compared to *Stephanotis*, but in the case of one ♂ to *Freesia*, and in one ♀ Mrs. Longstaff thought the odour was "a little bit hair-oily."

Hebomoia australis, Butl. (Ceylon, 1908). Nine ♂, all those examined, had a heavy sweet scent, in most cases strong, in all decided: my wife and I compared it to the flowers of mango, or cinnamon. In 3 ♀ out of 4 there was a similar scent.

Meganostoma cerbera, Feld. (Venezuela, 1907). One out of three ♀ taken is noted as having had "a slight, very sweet scent; ? clover."

Ixias cingalensis, Moore (Ceylon, 1908). The 9 ♂ examined all had a sweet, but only moderately strong scent which reminded me of meadow-scent. Four ♀ were scentless.

PAPILIONINÆ.

Ornithoptera darsius, Gray (Ceylon, 1908). When at Kandy four years previously Mr. W. G. Freedley, junr., told me that the males of this species had a scent like sassafras, but I had no opportunity then of confirming his statement. Every ♂ that I examined during my more recent visit had a scent, some had a strong scent. At first I compared this to cinnamon and to Canada-balsam; to Mrs. Longstaff it suggested rosemary or "rose-scented hair-oil." Later by the kindness of the Apothecaries Company of Colombo I received through the post a sample of the oil of sassafras, so that I made a direct comparison, with the result that the odours of the oil and the butterfly appeared to be almost identical. The ♀ had an odour like musty straw.

Papilio hector, Linn. (Ceylon, 1908). The ♂ has a musty odour.

Papilio aristolochiæ, Fabr. (Ceylon, 1908). Both sexes have an odour like musty hay. In the case of a ♂ specimen there is a note: "decided disagreeable smell: ? like new black net."

Papilio demoleus, Linn., *erithonius*, Cram. (Ceylon, 1908). A smell like fresh straw was detected in one specimen, a ♂, in another (a ♀) there was "a slight peculiar scent in the field: stronger in the house."*

* Compare *Dixey*, Trans. Ent. Soc. Lond., 1906, p. v, as to the scent of the allied *P. demodocus*, Esp.

Papilio polydamus, Linn. (Jamaica, Trinidad, Venezuela, 1907). An odour resembling that of musty hay, or straw, was detected in 2 specimens of each sex. My wife compared the scent to rue.

Papilio eurimedes, Cram. (Venezuela, 1907). A ♂ had a strong musty straw odour.

Papilio xeneides, Esp., *gargarus*, Hübn. (Trinidad, 1907). A living ♀ had a smell of musty straw, which persisted after death.

HESPERIIDÆ.

As yet I have never been able to satisfy myself that any of the Skippers are scented. Dr. Dixey, however, once found a very distinct smell of chocolate in a specimen of *Gegenes occulta*, Trim.* It seems probable that some special manipulation may be requisite to elicit scents in this group.

§ 2. *The Coloured Juice exuded by certain Lepidoptera.*

It has long been known that some butterflies, notably *Danainæ* and *Acræinæ*, yield a copious yellow or green juice on pinching, and this has been commonly associated with the known, or suspected, distastefulness of the insects themselves.† A devoted student of entomology, M. Félix Plateau,‡ has tried to get to the root of the matter by eating, or at any rate chewing, *Abraxas grossulariata* and its larva and pupa. Mr. Marshall has also tried many tasting experiments with South African butterflies.§ The results were in both cases inconclusive. Prof. Poulton thinks that this is only what might have been expected, since we have no right to suppose that a given butterfly tastes the same to us as to an insectivorous bird. It might be added that the likes and dislikes of our domesticated mammals differ from our own. I must confess that no enthusiasm has so far availed to bring me to the point of chewing a butterfly. However, in a few cases I have ventured to taste a minute drop of the yellow liquid, with somewhat unsatisfactory results.

Telchinia violæ, Fabr. (India, 1904). "When injured a

* Dixey, Trans. Ent. Soc. Lond., 1906, p. ii.

† See Dixey, loc. cit. pp. iii, iv, vi, vii.

‡ Mém. de la Soc. Zool. de France, Tome vii, 1894, p. 375, § 7.

§ Trans. Ent. Soc. Lond., 1902, pp. 405-414.

yellow juice exudes; a minute drop of this placed on the tongue tasted somewhat bitter and disagreeable, but the flavour was by no means strong.*

(Ceylon, 1908.) "The yellow juice slightly bitter."

Crastia asela, Moore. In two ♂ the juice was found to be tasteless: in another it had a slight, ? bitter, taste. In 2 ♀ it was noted as "nearly tasteless," "tasteless, or nearly so."

Pudemma sinhala, Moore (Ceylon, 1908). The yellowish juice of a ♂ is recorded as "? tasteless."

Isamia midamus, Linn.; *superba*, Herbst (Hong-Kong, 1904). "The yellow juice expressed by pinching has no marked taste."

A yellow juice, similar in appearance, has been noted in certain *Heterocera* believed to be distasteful. I give the instances which have attracted my attention.

Obeidia tigrata, Guén. (Hong-Kong, 1904). A conspicuous day-flying Geometer, allied to our Magpie-moth. Of this my note is: "Has a somewhat slow flight, and on the wing looks like a yellow butterfly; abundant and decidedly gregarious, many flying about one tree in the afternoon. When pinched it exudes a yellow juice having a bitter taste." I do not appear to have examined it for scent, but, whether or no it possesses an evil odour, it has other characteristics of a distasteful species.

Euschema transversa, Walk. (Ceylon, 1908). Of this handsome very slow-flying diurnal Geometer it is noted that it is extremely tenacious of life, but that its yellow juice is tasteless.†

Chaleosia venosa, Walk. (Ceylon, 1908). This day-flying moth flutters much about trees (especially *Litsea zelanica*, N. ab. E.), moving however faster from one tree to another when its flight is somewhat "vapouring." It is tenacious of life, resisting alike pinching and chloroform. It has a peculiar, faint, disagreeable odour, and exudes a yellow juice, the flavour of which still invites investigation.

In contrast to these somewhat ambiguous results is the conspicuous S. African Acridian, *Phymateus leprosus*, Serv.; when touched this emits copiously a dark olive-green very fetid fluid, which when accidentally tasted proved to be both bitter and unpleasant.†

* Longstaff, Trans. Ent. Soc. Lond., 1905, p. 103.

† Trans. Ent. Soc. Lond., 1906, p. 335.

§ 3. *The Tenacity of Life of Protected Species.*

That the *Danainæ* and some other butterflies have unusually tough integuments which enable them to resist injuries such as would rapidly prove fatal to the butterfly of ordinary constitution has been long well known.* So far the undoubted fact rests to a great extent upon general statements, but it has occurred to the writer that it may be capable of approximate numerical expression.

With tropical collectors it is a familiar experience that at the close of the day on opening the paper envelopes to examine their captures many of the butterflies are found to be still living. It is an equally general experience that this is especially frequent in the case of the *Danainæ*.

It has for some time past been my practice to enter in my note-book against the data referring to such long-lived individuals "Ten. Vit." (*tenax vitæ*). During my visit to Ceylon in the early months of 1908, I paid closer attention to the matter than previously, and feel confident that in the large majority of cases where a butterfly survived the first pinching the fact was duly recorded. The converse fact, that the insect was found dead in the envelope, was very rarely noted. Under these circumstances it may be fairly assumed that the numbers given below to measure the tenacity of life are, if anything, somewhat understated.

Some one will doubtless lodge the plausible objection that many of the butterflies in the table are large insects and consequently that they should often survive a pinch, such as proved almost uniformly fatal to smaller species, is only what might have been expected. This objection is disposed of by the fact that such a large butterfly as *Cynthia asela*, Moore, was never (13 specimens) found alive in the paper at the end of the day; the same is true of *Cethosia nietneri*, Feld. (9 specimens), and of the robustly made and swift-flying *Helioioia australis*, Butl. (13 specimens). Again, *Catopsilia pomona*, Fabr., is a fairly robust butterfly, yet out of 49 specimens 3 only, a ♂ and 2 ♀, were noted as "tenacious of life."

From my note-books and previously published papers I find that this resistance to death has forced itself upon my attention in the case of the following species:—

* See e.g. Poulton, "Essays on Evolution," 1908, pp. 279, 316. Cf. Bingham, loc. cit. p. 2. Also Marshall, Trans. Ent. Soc. Lond., 1902, pp. 322-323.

Isamia midamus, Linn. Hong-Kong, 1904. (MS. notes.)

Crastia amymone, Godt.; f. *kinbergi*, Wallgr. Macao, 1904. (MS. notes.)

Danaida chrysippus, Linn. India, 1903. Noted as resistant to cyanide as well as to pinching. (Trans. Ent. Soc. Lond., 1905, p. 98.)

Parnassius hardwickii, Gray. Himalayas,* 1903. "Delicate looking though it be, it is strangely tenacious of life." (*Ibid.* p. 69.)

Telchinia violæ, Fabr. India, 1904. (*Ibid.* p. 103.)

Chittira fumata, Butl. Ceylon, 1904. (*Ibid.* p. 131.)

Acræa cabira, Hopff. S. Africa, 1905. Noted as resistant to chloroform as well as to pinching. (*Ibid.* 1907, p. 328.)†

Anosia archippus, Fabr. Jamaica, 1907. (*Ibid.* 1908, p. 41.)

Danaida jamaicensis, Bates. Jamaica, 1907. (*Ibid.* p. 41.)

Danaida eresimus, Cram. Venezuela, 1907. (MS. notes.)

Heliconius charithonia, Linn. Jamaica, 1907. (*Ibid.* p. 42.)

Heliconius hydarus, Hew. Venezuela, 1907. (Entom. Month. Mag., 1908, p. 118.)

Actinote antea, Dbl. and H. Venezuela, 1907. (*Ibid.* p. 74.)

An examination of the following list of observations in Ceylon, January to March, 1908, shows, among other things, that whereas $\frac{3}{4}$ of the specimens of *Papilio hector* taken, and $\frac{3}{5}$ of those of *P. aristolochiæ*, are recorded as tenacious of life, this is *not noted of any* of the 9 specimens of *P. polytes*, 5 of *P. mooreanus*, 4 of *P. demoleus*, 3 of *P. terephon*, 7 of *P. erino*, and 14 of *P. agamemnon*.

So far as my observations go there is no difference in the powers of the two sexes of the butterflies here dealt with to resist injuries.

* In the discussion which followed the reading of the paper Dr. Chapman remarked that three or four pinches scarcely availed to kill the common Alpine *Parnassius apollo*, Linn.

† Mr. W. S. Loat, quoted by *Dixey*, Trans. Ent. Soc. Lond., 1903, p. 149, says of *Acræa vinidia*, Hew., on the White Nile, "takes a long time to die when put in the killing-bottle."

DANAINÆ.

	Total specimens taken.	Tenacity of life noted in
<i>Parantica aglea</i> , Cram. ...	31	17
<i>Tirumala septentrionis</i> , Butl. ...	18	9
<i>Pademna sinhala</i> , Moore ...	2	2
<i>Narmada montana</i> , Feld. ...	6	4
<i>Crastia ascla</i> , Moore ...	51	33
„ <i>core</i> , Cram. (Mátherán)...	6	4
<i>Chittira fumata</i> , Butl. ...	8	2
<i>Danaida plexippus</i> , Linn. ...	1	1
„ <i>chrysippus</i> , Linn. ...	4	0

PAPILIONINÆ.

<i>Ornithoptera darsius</i> , Gray ...	9	4
<i>Papilio hector</i> , Linn. ...	8	6
„ <i>aristolochiæ</i> , Fabr. ...	15	9
„ <i>parinda</i> , Moore ...	13	4
„ <i>lankeswara</i> , Moore ...	3	1
„ <i>jason</i> , Esp. ...	3	1
„ <i>teredon</i> , Feld. ...	3	0
„ <i>crino</i> , Fabr. ...	7	0
„ <i>agamemnon</i> , Linn. ...	14	0
„ <i>polytes</i> , Linn. ...	9	0
„ <i>mooreanus</i> , Rothsch. ...	5	0
„ <i>demoleus</i> , Esp. ...	4	0

ACRÆINÆ.

<i>Telchinia violæ</i> , Fabr. ...	10	3
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NYMPHALINÆ.

<i>Hypolimnas bolina</i> , Linn. ...	9	2
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PIERINÆ.

<i>Delias eucharis</i> , Dru. ...	26	3
<i>Catopsilia pomona</i> , Fabr. ...	45	3

HETEROCERA.

<i>Chalcosia venosa</i> , Walk.* ...	12	4
<i>Nyctemera nigrovenosa</i> , Moore ...	4	2
<i>Euschema transversa</i> , Walk. ...	2	1

* This species is resistant to chloroform.

§ 4. *Butterflies bearing marks of the attacks of foes.*

This very interesting bionomic point we owe almost entirely to Prof. E. B. Poulton, F.R.S., and Mr. Guy A. K. Marshall.* A list of the butterflies presumably injured by enemies noted by me in India comprised 31 specimens of 28 species.† I append further lists, which amply prove Prof. Poulton's statement that such specimens only want looking for. In nearly every case the injury is symmetrical, *i. e.* affecting the corresponding parts of both right and left wings, so that the probability of the injury being the result of damage during flight by branches or thorns is very small.

Neotropical Butterflies (West Indies, Venezuela, etc.), 1907.

Euptychia pharella, Butl. A small symmetrical injury to tips of fore-wings: ? by bird.

Euptychia hesione, Sulz. Symmetrical injury to middle of hind-wings: ? by bird.

Anartia jatrophæ, Linn. A big unilateral injury involving both right wings, noted before capture.

Cystineura dorcas, Fabr. Symmetrical injury to tips of hind-wings.

Didonis biblis, Fabr. ♀. Injury to anal angles of both hind-wings.

Myseelia cyaniris, Hew. Symmetrical injury to hind-wings: ? by bird.

Aganisthos orion, Fabr. Symmetrical injury to hind-wings: ? by lizard.

Colænis cillene, ♂. Nearly symmetrical injury to anal angles of fore-wings.

Colænis cillene, ♂. Symmetrical injury to hind-wings: ? by lizard.

Heliconius charithonia, Linn. ♂. Symmetrical injury to hind-wings.

Thecla togarna, Hew. ♀. Symmetrical injury to hind-wings, involving lobes and tails.

Glutophrissa drusilla, Cram. ♂. Symmetrical injury to both hind-wings: ? by lizard.

* Poulton, "Essays on Evolution," 1908, pp. 270, 281-3, 325, as well as the references there given.

† Trans. Ent. Soc. Lond., 1905, p. 134.

Terias delia, Cram. ♀. Symmetrical injury to hind-wings.

Terias messalina, Fab. ♀. Symmetrical injury to hind-wings.

Ceylon, 1908.

Crastia asela, Moore, ♀, nearly all hind margin of right fore-wing and apex of right hind-wing gone.

Crastia core, Cram. (Mátherán, India). Symmetrical injury to hind-wings.

Narmada montana, Feld. ♂. Symmetrical injury to fore-wings.

Ypthima ceylonica, Hew. Small symmetrical injury to fore-wings: ? by bird.

Melanitis leda, Linn. Symmetrical injury to anal angles of fore-wings: ? by bird.

Neptis varmona, Moore. Symmetrical injury to fore-wings: ? by lizard.

Cethosia nictneri, Feld. ♀. Symmetrical injury to middle of hind-wings.

Cethosia nictneri, ♀. Symmetrical injury to tips of fore-wings.

Cynthia asela, Moore, ♀. Large symmetrical injury to hind-wings: ? by lizard.

Cynthia asela, ♂. Symmetrical injury to hind-wings: ? by bird.

Cirrhochroa cognata, Moore, ♀. Symmetrical injury to hind-wings.

Hypolimnas bolina, Linn. ♀. Symmetrical injury to fore-wings: ? by bird.

Hypolimnas bolina, ♂. Symmetrical injury to tips of fore-wings.

Pyrameis cardui, Linn. ♂. Symmetrical injury to hind-wings: ? by lizard.

Lampides celeno, Cram. ♂. Symmetrical injury involving whole hind-margin of hind-wings and an angular piece of fore-wings: ? by lizard.

Delias eucharis, Dru. ♂. Symmetrical injury to hind-wings.

Catopsilia pomona, Fabr. ♂. ? Two symmetrical bites involving both hind-wings.

Catopsilia pomona, ♀. Symmetrical injury to hind-wings: ? by bird.

Catopsilia pomona, ♂. All four wings symmetrically injured by one small bite: ? by bird.

Ornithoptera darsius, Gray, ♀. Long narrow symmetrical injury to hind-wings: ? by bird.

Papilio agamemnon, Linn. Symmetrical injury to hind-wings: ? by lizard.

Algeria, 1905.

Euchloë belia, Linn. ♀. Very sharply cut snip out of each hind-wing, larger on left: ? by bird.

Ganoris brassicæ, Linn. Caught fluttering about flower-bed close to the ground, had been nearly done for by a (?) bird; nearly the whole of both hind-wings and three-fourths of the fore-wings gone.

Hong-Kong, 1904.

Papilio paris, Linn. Almost symmetrical injury to all four wings, large pieces gone.

§ 5. *Experimental Evidence as to the Palatability of Butterflies.*

The following experiments, conducted at the suggestion of Prof. Poulton, are a small contribution to the mass of facts accumulated by Mr. Guy A. K. Marshall and Mr. Frank Finn.*

At our hotel at Kandy were two Mainas (*Gracula*), talking birds of the Starling family (*Sturnidæ*). These birds, which were very tame, were confined in two fairly roomy cages three or four yards apart. I will call the birds A and B.

19 January, 1908. Bird A was given 5 dead butterflies in the following order:—*Atella phalanta*, *Polyommatus bæticus*, *Loxura arcuata*, *Neptis varmona*, *Telchinia violæ*. The bird gave the *Loxura* a few pecks and then let it alone. The tough integument of the *Telchinia* seemed to give the Maina much trouble, but it showed no evidence of disgust. The other three butterflies were taken greedily, the bird, like Oliver Twist, obviously asking for more. It shook the butterflies as a dog shakes a rat.

* Marshall, Trans. Ent. Soc. Lond., 1902, pp. 297-397; Finn, Journ. Asiat. Soc. Bengal, LXIV, Pt. ii, 1895, p. 344; LXV, Pt. ii, 1896, pp. 42; LXVI, Pt. ii, 1897, pp. 528, 613, 667-8; quoted by Poulton, "Essays on Evolution," 1898, pp. 269, 317. See also Marshall, Trans. Ent. Soc. Lond., 1908, pp. 137-142.

21. January, 1908. Bird A appeared to be very anxious to be fed. I gave it a dead *Catopsilia pomona*, ♀, which it pecked to pieces: next a dead *Parantica aglea*, it ate its abdomen: then a dead *Papilio aristolochiæ*, after giving this several pecks it left it and did not touch it again. I then gave it two *Crastia asela*, both alive; the fact of life seemed to interest the bird and it tried each of the specimens twice but then appeared to be disgusted and refused even to look at any of the following, of which dead individuals were put into its cage: *Papilio agamemnon*, *Jamides bochus*, a small *Lycænid* (probably either a *Catochrysops* or a *Nacaduba*), *Loxura arcuata* and *Neptis varmona*.

Same day. Gave bird B a dead *Atella phalanta*, which it ate; after this a living *Crastia asela*, it pecked this several times but did not eat it.

23 January, 1908. Bird A was busy preening its feathers and appeared to have just been fed; I could not attract its attention. While thus engaged bird B sought to attract *my* attention, so I gave it in succession dead specimens of:—*Ergolis* sp., *Telchinia violæ*, *Delias eucharis* and *Papilio aristolochiæ*. It gave the two first a few pecks; the *Delias* it pecked once or twice, but it gave the *Papilio* a single peck only. Perhaps it was not hungry.

I then put the last two butterflies into the cage of bird A. It pecked the *Delias* several times, but the *Papilio* only once or twice. After this it declined even to look at the *Papilio* any more, but came to the front of its cage repeating again and again what sounded extremely like "No good! No good!"

2 February, 1908. Gave Maina A a dead *Nissanga patnia* which it appeared to eat.

4 February, 1908. The Mainas had evidently been fed: there was food in their cages and bird A had upset its food.

Gave A an *Ergolis* sp., which it ate.

Gave B a *Nissanga patnia*; it ate it.

Offered a living *Hypolimnys bolina*, ♂, first to one bird, then to the other; each pecked its wing, but no more.

Bird A would not look at *Cirrhochroa cognata*.

I came to the conclusion that the birds were not hungry, and therefore the observations of little value.

- 7 February, 1908. Offered to two young chickens first a *Papilio aristolochiæ* and then a *P. polytes*, ♂. One of them looked at the first-named and then walked away; neither looked at the *polytes*.

The same two butterflies were then offered to Maina A, which pecked at both several times, then wiped its beak and left them.

This day's experiments were considered unsatisfactory at the time; it was nearly 6.0 p.m., and perhaps the birds were sleepy.

- 14 February, 1908. Gave bird A a *Lampides* sp.; it ate it and looked about for more.
- 15 February, 1908. Gave bird A 2 *Ypthima ceylonica* and 1 *Lampides* sp.; it ate them all three. A *Neptis varmona* was then offered to the same bird, which gave it but one peck. The *Neptis* was then offered to bird B, which also gave it one peck.
- 16 February, 1908. Gave to bird A three butterflies, *Lampides* sp., another Lycænid (species not noted), and a *Nissanga patnia*: it ate them all up completely. Another specimen of the *Nissanga* was swallowed at the second attempt. An *Ergolis* sp. was also eaten and swallowed. I then offered the same bird a *Papilio aristolochiæ*, this after a peck or two was left. The same specimen was then offered to bird B, which would not touch it. It was then handed back to bird A, which gave it another peck and again left it.

So far as these experiments teach anything, it would appear that these Mainas would eat with relish *Nissanga patnia*, *Ypthima ceylonica*, *Atella phalanta*, *Ergolis* sp., and *Lampides* sp.

On the other hand, *Papilio aristolochiæ* and *Crastia asela* were distinctly distasteful.

The evidence as to the other species experimented with fails to convince me one way or the other.

§ 6. *Mimics in the Field deceiving Man.*

It may not be without interest to record a number of cases in which a collector with defective eyesight has

actually been deceived (at any rate momentarily) by Mimics in the field.*

Benares, 30 November, 1903. When I first captured *Hypolimnas misippus*, ♀, I believed it to be a variety of *Danaida chrysippus*, and I think it probable that other specimens were passed over, as ♂ were very common.†

Anantápúr, February, 1904. This note was made:—
“Several times saw the ♂ *H. misippus*, reconnoitring *D. chrysippus*, as if in doubt as to its identity.”‡

Malakand, 29 October, 1903. The ♀ *Argynnis niphe* flying about flowers was noticed to resemble *Danaida genutia*, which was in abundance at the same flowers, though in this case there was no actual deception. §

Konúr, Nilgiris, February, 1904. “On one occasion I watched a ♀ of *Argynnis niphe*, under the impression that it was *Limnas chrysippus*! The resemblance on the wing is greater than might be supposed.” ||

Horton Plains, Ceylon, 23 March, 1904. “*Argynnis niphe* . . . the ♀ on the wing looking very like *Limnas chrysippus*.” ¶

Hatton, Ceylon, March, 1908. The following extracts from my note-book point to the striking difference in the general look of the two sexes of *A. niphe* when on the wing:—

“a ♀, captured as *Limnas chrysippus*.”

“a ♂, looked like a fritillary.”

I would urge strongly that the resemblance of model to mimic may be much closer in the field than in the cabinet.

Báliganj, Calcutta, 5 December, 1903. “The ♀ *Elymnias undularis*, Dru., is a very fair mimic of *Danaida genutia* but its flight is weaker.” **

Kandy, 9 February, 1908. A tattered ♀ of *Elymnias fraterna*, Butl., was taken for a tattered *Danaida chrysippus*.

* In addition to the disadvantages inseparable from the loss of the sight of one eye, the writer is both myopic and astigmatic; his astigmatism being only in small part capable of correction by optical means.

† Trans. Ent. Soc. Lond., 1905, p. 84.

‡ Loc. cit. p. 109.

§ Loc. cit. p. 74.

|| Loc. cit. p. 113.

¶ Loc. cit. p. 132.

** Loc. cit. p. 89.

Haragáma, Ceylon, 13 February, 1908. A ♀ *Nepheronia ceylonica*, Feld., on a *Lantana* flower, was taken for *Parantica aglea*.

Durban, S. Africa, August, 1905. *Acræa encedon*, Linn., a somewhat feeble insect with slow flight, was, in spite of its small size, twice momentarily believed to be *D. chrysippus*, which was seen in the same spots on the same days. On the other hand, a small ♀ *D. chrysippus* was actually mistaken for *A. encedon*.*

Durban, August, 1905. "Of *Belenois thysa*, Hopff., we took two ♂; when on the wing they were very like the ♂ of *Mylothris agathina*, Cram., in flight and general aspect. Indeed as seen in the net the *Belenois* so closely mimics the *Mylothris* that one of us, though specially on the look out, was completely deceived, and this even when the two insects were taken the same morning."†

Durban, August, 1908. "... the curious Geometer *Cartaletis libyssa*, Hopff., of which several were seen, but only one taken. It flies rather high, with feeble fluttering action, and when on the wing somewhat recalls *Limnas chrysippus*."‡

Kandy, March, 1904. "Of the tail-less *Papilio lankeswara*, Moore, f. *dissimilis*, Linn. (the pale form), I took three, but probably saw more since it so very closely mimics *Tirumala limniace*, or a large *Parantica ceylonica* (*aglea*), as easily to pass for one of those insects; it is indeed most easily distinguished from them by its habit of fluttering while feeding upon a flower."§

Near Peradeniya, Ceylon, 29 January, 1908. I was with that experienced and keen-eyed entomologist, Mr. E. E. Green, when he netted a *P. lankeswara*, f. *dissimilis*, under the impression that he was catching *Tirumala septentrionis*, Butl.

Kandy, 2 March, 1908. I myself took a ♀ *P. dissimilis* which I imagined to be *Tirumala septentrionis* as it flew past.

Haragáma, Ceylon, 18 February, 1908. Took a ♀ *P. lankeswara*, f. *clytia*, Linn. (the dark form), believing it to

* Trans. Ent. Soc. Lond., 1907, pp. 318, 321, 328.

† Loc. cit. p. 325.

‡ Loc. cit. p. 327.

§ Trans. Ent. Soc. Lond., 1905, p. 124.

be *Crastia asela*, Moore. This dimorphic mimicry is very remarkable.

Mortehoe, Devon, July, 1902. The first specimen of *Egeria crabroniformis*, Lewin, that I ever saw alive was at rest on the trunk of a black poplar. Under the idea that it was a hornet I knocked it down and put my foot on it before discovering my mistake.*

Kandy, 21 February, 1908. A specimen of the Clearwing, *Melittia chalciformis*, Fabr., seen hovering over a flower was first thought to be a *Bombylius*, then a Skipper. It distinctly hummed in the net. This instance is quoted to show that the moth, though not suggesting a protected insect, certainly deceived the observer.

Simon's Town, S. Africa, 3 October, 1905. I had much difficulty in distinguishing during life some flies—? *Psoas* sp., and *Prorachthas* sp.—which closely mimicked certain small black, white-ringed Bees, *Halictus albofasciatus*, Smith, ♂, which buried themselves in the flowers of a large *Mesembryanthemum*. In the cabinet the insects look distinct enough, but during life the resemblance, especially in their movements and habits, was very striking.†

Mátherán, W. Gháts, 1908. At the end of March, in a time of extreme drought, insects of various orders were, naturally enough, attracted to such pools as were left about the nearly exhausted springs. Among the visitors were many long-waisted wasps of which I secured a fair number, belonging, as I supposed on a cursory glance, to several species. When Mr. A. H. Hamm had set these for me at Oxford, he remarked, "I see that you have taken a lot of *Conops* along with the wasps that they mimic." Critical examination revealed: HYMENOPTERA:—*Eumenes* ? *arcuatus*, 3; *Eumenes* sp., 1; *Polistes* ? *stigma*, 3; *Icaria* ? *ferruginea*, 1. DIPTERA:—*Ceria eumenoides*, 7; *Conops* sp., 3.

Mortehoe, Devon, August, 1908. Two specimens of the common British Conopid fly, *Physocephala rufipes*, Fabr., suggested to me when alive a *Trochilium* (Clear-wing moth) rather than a wasp.

* Entom. Month. Mag., 1903, p. 196.

† Trans. Ent. Soc. Lond., 1907, p. 380.

Mortehoe, 25 August, 1908. The Syrphid fly, *Chilosia illustrata*, Harr., is common, sometimes abundant, at Mortehoe on the flowers of Ragwort, *Heracleum*, *Angelica*, etc., where it mimics *Bombus sylvarum*, Linn., and the more local *Anthophora fuscata*, Panz., sufficiently closely to have deceived for the moment such an experienced hymenopterist as Dr. H. Swale.

Of course we can form but a very imperfect idea of the sense impressions of the lower animals. We know by their actions that hawks see their prey from a considerable distance. The phenomena of mimicry compel the inference that insectivorous birds, and possibly lizards, appreciate comparatively minute differences of shape and colour, yet it is quite conceivable that they cannot distinguish these at a greater distance than a myopic man. We know even less about the sense impressions of insects, in spite of the patient observations of Forel and Lubbock, and the brilliant experiment of Exner. The whole subject is discussed in detail by Dr. Auguste Forel, who seems to have established the fact that insects have a very keen perception of movement—possibly far more acute than their sense of form and colour.* It has often occurred to me when collecting butterflies that it is just possible that they can smell a collector as far as they can see him.

§ 7. *Notes on the flight of sundry Butterflies.*

Too many systematic works deal with insects as mere cabinet specimens, though there are notable exceptions. Not the least valuable part of the late Mr. C. G. Barrett's great work on the "Lepidoptera of the British Islands" is his vivid description of their habits and flight. Again in Moore's "Lepidoptera of Ceylon" the short notes on the mode of flight of many species supplied by Capt. H. Wade-Dalton, Mr. F. M. Mackwood and more frequently Capt. F. S. Hutchison are of great interest. The value of the notes in the last-named work is not diminished by the fact that the observers are not always agreed. The habits of the sexes are usually different; the time of day, not to speak of the weather, greatly affects their flight; probably the time that has elapsed since emergence from the pupa is

* Forel, "The Senses of Insects." Translated by Macleod Yearsley, 1908, *passim*.

another important factor. Hence it follows that hasty generalisations based on the most accurately recorded observations may be most misleading if the qualifying circumstances be left out of account.

The first fact that I would emphasise is the rapid flight of the Whites and Yellows.* That Pierines may be seen fluttering slowly about flowers is true enough,—*e.g.* that *Colias edusa* is not always difficult to catch. Nevertheless Pierines have a knack of flying straight on, as if bound to reach some distant place at a definite time, in a way that Satyrines certainly are not given to. Again, though the Nymphaline may go off at a great pace for a short distance, it usually soon returns to its beat. Among many swiftly flying Pierines that I have come across, are:—*Catopsilia* and the allied genera *Callidryas*† and *Gonepteryx*; the Neotropical *Giletaphrissa drusilla*, Cram., and more especially *Pieris phileta*, Fabr.‡; the powerful Oriental *Hebemoia*§; again *Ixias pyrene*, Linn.,|| though not equal to the last named, is a swift flier, as are also many of the *Teracoli*, notably the South African *T. eris*, Klug.¶

Commander J. J. Walker, R.N., writing of *Euchloë belemia*, Esp., at Gibraltar, Tangier, etc., said: "It has a very strong, swift, and erratic flight, and is by no means easy to catch."** Even the little *Terias*, which seems to go slowly, will be found to move so fast that a large proportion get away, though in this instance the mode of escape is commonly to dart downwards so that the net passes over it, and to the annoyance of the collector the fly rises from the ground.†† There seems to me to be practically no doubt that the swift flight of the Whites and Yellows is due to their exceptional conspicuousness as compared with other butterflies. That they are exceptionally conspicuous is obvious enough.

But not all Pierines are rapid fliers; there are marked and significant exceptions. Thus, many years ago, Mr. A. R. Wallace,‡‡ writing of the Oriental genus *Thyca* (*Delias*), said: "They have a very slow and weak mode of

* Trans. Ent. Soc. Lond., 1905, pp. 67, 75, 76, 112.

† *Ibid.* 1908, p. 55.

‡ *Ibid.* 1908, p. 49.

§ *Ibid.* 1905, pp. 116, 126, and subsequent experience in Ceylon,

|| *Ibid.* 1905, p. 79. Also MS. notes in Ceylon, 1908.

¶ *Ibid.* 1907, p. 352.

** *Ibid.* 1907, p. 48.

†† *Ibid.* 1890, p. 369.

‡‡ *Ibid.* 1865-8, p. 309.

flight." Again at East London Dr. Dixey* called my attention to the 'slow, fearless, fluttering flight' of *Mylothris agathina*, Cram. Both *Delias* and *Mylothris* furnish well-known models, closely mimicked by other Pierines. Dr. Dixey noted that the flight of the mimic *Belenois thysa*, Hopff., closely resembled that of its model *Mylothris agathina*, but Mr. E. E. Green tells me that *Prioneris sita*, Feld., a very close mimic of *Delias eucharis*, Cram., is a swift flier.

Probably belonging to a different category are two smaller Pierines of dissimilar structure, but similar appearance, the Palearctic *Leucophasia sinapis*, Linn., and the Oriental *Nychitona xiphia*, Fabr.,† which are among the very feeblest fliers of my acquaintance.

The slow gliding, floating (Hutchison), or skimming flight of certain Nymphalines such as *Neptis*, *Rahinda*, *Ergolis* and *Eurytela* is well known to tropical collectors, what its significance may be I know not. My experiments indicate that *Ergolis* is palatable.‡

It has not been my good fortune to capture that fine butterfly *Parthenos cyaneus*, Moore, but at Kandy I watched its tantalising movements for some time as it flew to and fro far above my longest net-stick. Messrs. De Nicéville and Manders say of this species:—"not rare, but is difficult to catch. It has a remarkably distinctive mode of flight, which makes it recognisable at once on the wing."§ As those gentlemen make no endeavour to describe its peculiarity I will do my best to do so. The wings appear to be seldom raised much above the horizontal, but at comparatively long intervals they are strongly depressed with a jerk, the fly then gliding along for two or three yards. In marked contrast to this is the flight of *Papilio parinda*, Moore, which is attended with obvious flapping in which the wings are much raised but not appreciably depressed below the horizontal. I am glad to be able to add that Mr. E. E. Green agrees with the general accuracy of this description.

The slow heavy flight of the Danaines is of course familiar; I might specially mention *Crastia asela*, Moore, *Narmada montana*, Feld., *Chittira fumata*, Butl., and *Parantica aglea*, Cram. I am not aware that the peculiar dancing

* Trans. Ent. Soc. Lond., 1907, pp. 314, 325.

† *Ibid.* 1905, p. 79. Also Ceylon, 1908. ‡ *Supra*, pp. 124, 125.

§ Journ. Asiatic Soc. of Bengal, vol. lxviii, 1899, p. 188.

movement—up and down—of the two last-named has been placed on record: yet it is often so marked as to enable one to diagnose the insects at a considerable distance. At Kandy late in the afternoon, when other butterflies were getting scarce, *P. aglea* might often be seen slowly dancing about in all directions.

At the falls of the Zambesi I noted *Papilio leonidas*, Fabr., as flying slowly "with the manner of a Danaid"; this made me suspect it to be a mimic, as I afterwards found to be the case.* Mr. Marshall, who is quite familiar with the insect, whereas I have seen but very few specimens, speaks of *P. leonidas* as having a strong and rapid flight, and always going straight ahead.† I think there must have been some special circumstance that caused my specimens to behave in an unusual manner. Certainly its alleged model, *Tirumala petiverana*, did not put in an appearance.

The flight of *Cethosia nietneri*, Feld., another Ceylon butterfly, is I think about the slowest and feeblest that I have observed, and this alike whether it be high up or near the ground. (MS. notes.) The S. African Nymphaline *Salamis anacardii*, Linn., is another remarkably slow flier.‡

As a general rule tropical butterflies seem harder to catch than British. Certainly this is not entirely to be explained by the heat, nor even by swiftness of flight. The slow-flying *Mycalesis* seldom moves far, and is for that very reason hard to catch as it seldom gets quite clear of the herbage amongst which it is found. Again *Elymnias* often refuses to move more than two or three yards when disturbed, yet is hard to catch because it will not get clear of the bushes in the middle of which it loves to flutter. A very different butterfly, the lovely blue *Nepheronia ceylanica*, Felder, a quick flyer, often takes refuge in bushes when pursued; *Teracolus paellaris*, Butl., has a similar habit. *Belenois mesentina*, Cram., and the two common Indian species of *Ixias* seem to spend much of their time flying through and through thorn bushes.§

Three years ago || I called attention to the curious habit of the ♂ *Catophaga paulina*, Cram., of flying in strings as though tied together by an invisible thread. I witnessed this

* Trans. Ent. Soc. Lond., 1907, p. 359.

† *Ibid.* 1902, p. 507.

‡ *Ibid.* 1906, p. 114; also *Ibid.* 1907, pp. 321, 322, 325.

§ *Ibid.* 1905, pp. 75, 80, 89. || *Ibid.* p. 130.

again at Haragúma, Ceylon, 20 January, 1908. Soon after mid-day large numbers of the ♂ were seen flying down the bed of the stream, sometimes in ones and twos, but often 3, 4 or 5 together in strings. On the same day clusters of a score or more were seen drinking at wet sand; when disturbed they would quickly come back to the favoured spots, as many as 5 to 7 together, in strings, all conforming to the movements of their leader like wild geese.

Melanitis leda, Linn., is an insect with which I have been unfortunate, never having come across it in any numbers. At the beginning of February 1908, I twice witnessed its evening flight—at about 6.30 p.m. when it was nearly dark. My net-stick consists of two lower joints of a salmon-rod; on the occasion referred to the butt-joint, which is partly covered with cork, was lying near me on the ground. The butterfly flew in jerks, making short circuits and returning again and again to settle on my hat, my net, or the net-stick on the ground. It struck me at the time that it might probably be guided by the sense of smell, especially as it selected the part of my net-stick that was most handled. Yet it is quite possible that the butterfly was attracted by my white tropical clothing, and by the light colour of the cork, which was fairly conspicuous in the increasing gloom under the palms. One evening when strolling in the hotel garden alone in search of *leda* a leaf of a coco-nut palm fell close to me with a positive crash; when one considers that it measured between 11 and 12 feet long it can be understood that I was not a little startled.

The Ceylon *Papilio*s would appear to be more easily netted in the afternoon than in the morning; this is especially the case with *Ornithoptera darsius*, Gray, and *P. parinda*, Moore.

P. demoleus, Linn., is swift of flight; so is *P. agamemnon*, Linn., which has a darting movement. The last-named is quite an inconspicuous butterfly whether on the wing or at rest, affording a marked contrast to the glorious *P. erino*, Fabr., which is almost startling in its brilliance.

The flight of *P. hector*, Linn., is not especially swift, but is marked by the straightness of its course, seeming to keep on one level. Its black, white and scarlet colouring is very obvious in flight, and the strong contrast of colours seems to make the movement of its wings more obvious and more rapid in appearance.

In marked contrast with the last is *P. aristolochiæ*, Fabr., which sails about slowly and quietly with little obvious flapping of the wings; it moves about in a stately way as if confident in its immunity from attack and is the most easily caught of all the group.

P. polytes, Linn., two of whose polymorphic ♀ mimic *hector* and *aristolochiæ* respectively, behaves very differently from them and seems to trust much to swiftness of flight; my observations chiefly relate to the ♂, and I have an impression that the flight of the ♀ is slower, but this requires confirmation. Though well known to Indian entomologists I am not aware that the contrast in flight between *polytes* and *aristolochiæ* has yet been placed on record.

It is a notable habit with many *Papilios* that when settled on flowers feeding they keep their wings in almost constant movement.* This has been noted in all the following species:—*O. darsius*; this when feeding occasionally stops fluttering, dropping the fore-wings back (towards the abdomen); *P. parinda*, *P. hector*, *P. aristolochiæ*, *P. polytes*, *P. agamemnon* (the habit is very marked in this species), *P. demoleus*, *P. demodocus*, *P. dissimilis* and *P. mooreanus*, Rothsch. (a race of *helenus*, Linn.).

I was much struck by specimens of the last-named in the forest at Hatton, Ceylon (5 March, 1908), settled on very dark grey rocks drinking, with their wings about $\frac{3}{4}$ expanded, but with the fore-wings drawn back so as almost entirely to conceal the conspicuous cream-coloured spot on the hind-wings. For the moment I thought that there was before me some other species, entirely black on the upper side.

P. terephon, Feld. (*sarpedon*, Linn.), and *P. jason*, Esp. (*telephus*, Feld.), do not flutter when drinking.

§ 8. *The selection as resting-places of Yellow Leaves by Yellow Butterflies.*

As there still appear to be entomologists of wide experience who doubt whether butterflies, impelled by instinct, ever select resting-places of like colour with themselves,

* Longstaff, "Some Rest Attitudes of Butterflies," Trans. Ent. Soc. Lond., 1906, p. 111.

it seems worth while to bring together the following observations.*

It is a singular coincidence that on passing through the garden of the University of Bombay, 22 March, 1908, I again saw a *Catopsilia* and watched it settle on a shrub: this was not a yellow-leaved plant, as on the former occasion, but its leaves varied a good deal in colour and the butterfly settled on the yellowest: it was certainly much less conspicuous than it would have been on the greenest leaf: a German fellow-traveller whose attention I called to the butterfly agreed as to the partial concealment by the similarity in colour.

Barbados, 18 December, 1906. A ♀ of *Callidryas eubule*, Linn., was seen, when a cloud passed over the sun, to flutter about some herbage for a short time, as though looking for something, and finally to settle on a yellow leaf of the "Life Plant," *Bryophyllum calycinum*, Salisb.

Constant Spring, Jamaica, 8 January, 1907. Two specimens of *C. eubule* (sex not recorded) were seen when the sky was dull to settle on the lower, yellowish leaves of *Plumbago scandens*, Linn., close to the ground.

Mackfield, Jamaica, 27 January, 1907. I was watching the movements of a ♂ *C. eubule*, when a cloud passed over the sun; after fluttering about for a very short time it settled in the middle of a yellow, lower leaf of the *Bryophyllum*.

Montego Bay, Jamaica, 4 February, 1907. A ♀ *C. eubule* was seen flying across the race-course. The track was carpeted with short grass of a rich full green, but amongst the grass were long trailing stems of the *Ipomœa pes-capræ*, Sw.; on one of these stems was a solitary bright yellow leaf, far from any other of like colour, on this the yellow butterfly settled.

Montego Bay, Jamaica, same day. A ♀ *C. eubule* was seen to settle on an isolated yellow leaf of a creeper in a hedge, about 6 feet from the ground, all the surrounding foliage being green.

* See Longstaff, Trans. Ent. Soc. Lond., 1906, pp. 113-118. Also Dixey, Proc. Ent. Soc. Lond., 1906, p. xxix, who, in the discussion following the reading of the paper first quoted, gave several interesting instances from various authors. Also Hamm, Proc. Ent. Soc. Lond., 1904, p. lxxv; 1905, pp. lxxiii-lxxvi; 1906, pp. c, ci.

Constant Spring, Jamaica, 4 January, 1907. A dull afternoon: a ♀ *Terias euterpe*, Mén., was seen to settle close to a leaf of its own size, shape and colour. Same place and day. A ♂ *T. euterpe* was watched for some time and repeatedly disturbed; it seemed to avoid dark green foliage, and always settled on a low plant with yellow-green leaves.

Mackfield, Jamaica, 27 January 1907; 4.30 p.m. A specimen of *T. euterpe* seen to settle four times as follows:—

- (1) On a yellowish leaf of *Bryophyllum*: it was, however but ill-concealed thereby.
- (2) On a *pale* green leaf.
- (3) On a yellowish-green, finely-cut fern (*Adiantum* sp.).
- (4) On a yellow-green leaf of a *Convolvulus* (or perhaps *Ipomœa*). In this case the concealment of the insect was remarkable.

Same place and day. Another specimen of *T. euterpe* was seen to settle on the under side of a yellowish leaf of the *Bryophyllum*.

Same place and day. A ♀ of *T. euterpe* was seen to settle three times:—

- (1) On a yellow leaf of *Bryophyllum*; fairly cryptic.
- (2) On a light green leaf of an unknown plant, somewhat cryptic.
- (3) On a leaf of *Bryophyllum* less yellow than (1), the result less cryptic.

Mackfield, Jamaica, 31 January, 1907. Three specimens of *T. euterpe* (sex not determined and specimens not preserved) were watched with the following results respectively:—

- (1) Seen to settle on a yellow leaf of *Bryophyllum*.
- (2) Seen to settle three times, twice being on yellow leaves of *Bryophyllum*.
- (3) Seen to settle seven times. Twice on yellow leaves of *Bryophyllum* (in one case it was *very* well concealed); twice on a yellow fern (? *Polypodium* sp.); one other time it was well concealed, but the plant not noted; on two occasions it was less well concealed.

Constant Spring, Jamaica, 1 January, 1907. A ♀ of *Terias* (? *clathea*, Cram.) was seen to settle in the shade on a leaf of the same colour as the under-side of its hind-wings.

Haragáma, Ceylon, 13 February, 1908. I watched a specimen of *Ixias pyrene*, Linn., f. *cingalensis*, Moore, a ♀, settle three times upon the yellowish leaves of the same (now) widely distributed *Bryophyllum*.*

It should be noted that the faded leaves of the *Bryophyllum* have their margins tinted a purplish-red, resembling in colour the markings found on the under side of dry-season specimens of *Callidryas cubule* and *Ixias pyrene*.

With such facts before me I cannot but believe that the butterflies in question instinctively sought out leaves more or less closely resembling themselves in colour, with a view to concealment.† Undoubtedly the most conspicuous butterflies on the wing are "Whites" and "Yellows." On the move they are protected by their extremely rapid flight, but when at rest they stand in need of special protection. Many of these butterflies are restless and rarely settle, except to feed on flowers, to drink at damp places, or in the case of females to oviposit. To see them go to rest requires both time and patience; the best way being to watch them the moment that a cloud passes over the sun. I have very little doubt that our own Brimstone and Clouded-yellows if watched patiently will be found to seek out yellow resting-places.‡

§ 9. *Heliotropism*.

In a paper read before this Society in March 1906,§ I laid stress upon the habit of many butterflies, when settling in the sunshine, and—when not interfered with by wind or the exigencies of getting food—placing themselves with expanded wings and with their tails turned

* It is perhaps worth recording that at Kandy, in the spring of 1908, the ♂ of *Catopsilia pomona* was on dull days several times beaten out of *Tithonia diversiflora*, a tall, rank-growing, yellow-flowered Composite, said to have been recently introduced into Ceylon from Mexico, and now spreading rapidly. The butterfly seemed to rest among the leaves near the tops of the shoots, but I was not able actually to see it at rest.

† Compare Mrs. Barber's observation on the care exercised by *Papilio dardanus*, a ♂, in selecting a suitable resting-place. *Trimen*, South African Butterflies, vol. iii, p. 254. Quoted by *Marshall*, Trans. Ent. Soc. Lond., 1908, p. 122.

‡ Dr. T. A. Chapman has seen *C. edusa* select yellow leaves to rest upon. Proc. Ent. Soc. Lond., 1904, p. lxxvi.

§ Trans. Ent. Soc. Lond., 1906, p. 97-106.

towards the sun. For shortness of expression I described a butterfly so placed as "oriented." The butterflies observed were for the most part Satyrines and Nymphalines, and the observations were made in Northern India, Algeria and South Africa, as well as in England. Without pledging myself to any explanation of this habit, I was inclined to attribute it to the diminution of its shadow when the orienting butterfly closed its wings, whereby the insect was rendered very inconspicuous.

To the number of orienting butterflies previously given may now be added the Neotropical Nymphalines, *Precis lavinia*, Cram., *Anartia jatropha*, Linn., *A. amalthæa*, Linn., *Victorina stelenes*, Linn., and *Cystineura dorcas*, Fabr.

The details, taken from my note-book, follow:—

Constant Spring, Jamaica, 8 January, 1907. *Precis lavinia*, Cram., f. *zonalis*, Feld. Not uncommon, but hard to catch; usually settled on the ground with wings open; seen to orient and to put its wings up, causing little shadow; also to adjust itself after settling, so as to make the orientation more perfect; but also seen to face the sun.

Maraval, Trinidad, 19 December, 1906. *Anartia amalthæa*, Linn. Flies near the ground; settles with wings three-quarters open; orients, but not always.

Same place and day. *Anartia jatropha*, Linn. Has a ghostly flight; settles on the ground; orients.

Colon, Panama, 28 December, 1906. *A. jatropha*. This species orients, but not very regularly.

Constant Spring, Jamaica, 3 January, 1907. *A. jatropha*. Orients, but not very accurately; often closes its wings, and is then very cryptic among whitish dead grass.

Same place, 5 January. *A. jatropha*. The commonest Nymphaline: flies fast, close to the ground, looking very white. Usually settles on the ground or close to it; does not frequent flowers much; settles with the wings fully expanded, but often closes them over its back. Orients, but not accurately. Has however been noted with its wings up facing the sun; also once or twice across the sun.

Ramble, Jamaica, 24 January, 1907. *A. jatropha*. Orients.

Montego Bay, Jamaica, 2 February, 1907. *A. jatropha*, seen twice to settle on the whitish sand of the sea-

shore, to orient and close its wings, making no shadow.

Port Antonio, Jamaica, 4 March, 1907. The sun nearly vertical. *Victorina stelenes*, Linn., settled on leaves, once facing the sun, once head downwards, tail to the sun, wings closed and no shadow.

Ramble, Jamaica, 24 January, 1907. *Cystineura dorcas*, Fabr. Flies very slowly, close to the ground. Settles with wings nearly wide open, but it sometimes closes and then quickly re-opens them. When feeding on flowers, especially the Composite, *Bidens leucanthus*, W., it is indifferent as to its position with regard to the sun, but otherwise it usually orients, though it occasionally faces the sun.

Observations in Ceylon, 1908.

Precis iphita, Cram. This species was often observed. It most often settled with its wings closed, but frequently they were fully expanded. Though one specimen was seen to settle twice across the sun, it more usually either faced the sun or turned its tail to it.

Ypthima ceylanica, Hew. Ceylon. This species, which keeps close to the ground, settled occasionally with the wings open, more often half open, but most commonly closed. As regards orientation, it was noted to have its tail to the sun 10 times (once by adjustment), as against 7 times that it was across the sun.

Ergolis taprobana, Westw., and *E. ariadne*, Linn. May be conveniently taken together. They have a skimming or gliding flight which is not always checked by rain. They settle commonly with their wings fully expanded, but sometimes close them only to open them again. Most often they orient, but sometimes imperfectly; one was seen to adjust itself.

Nissangu patnia, Moore. This butterfly settled with its wings up (one exception) and so far as I observed with the eye-spot exposed. In the majority of cases it oriented.

Neptis jumba, Moore; *N. varmona*, Moore; and *Rahinda sinuata*, Moore. These three species may be conveniently taken together. They all have the same gliding flight and all settle most frequently with the wings fully expanded, though often closed. As regards orientation less than half the specimens observed appeared to pay any

attention to the direction of the sun's rays, though one *varmona* was certainly seen to adjust its tail to the sun.

Castalius rosimon, Fabr. Two specimens seen to orient with wings up.

Some English Satyrines.

I have previously recorded my experience * that in the great majority of cases *Pararge aegeria*, Linn., and *P. megara*, Linn., settle with their wings expanded and with their tails pointed towards the sun, though occasionally both species sit across the sun, but even in that case with wings expanded.

The following note may be added:—

Mortehoe, 14 September, 1907, late afternoon. *P. megara* found asleep upon the face of a rock, about 3 ft. above ground: its head up, antennæ porrected but separated; wings in close contact; fore-wings drawn back so that no fulvous colour was exposed.

Epinephele tithonus, Linn.

The following observations show that the habits of this butterfly, as regards orientation, are similar to those of *Pararge megara*.

Mortehoe, 20 July, 1906. *E. tithonus*. A specimen observed settled across the sun, with wings closed.

Same place and day. Another specimen seen to settle twice; oriented, with wings open.

Mortehoe, 11 August, 1907. A specimen settled on the ground, oriented, wings three-quarters open.

Mortehoe, 15 August, 1907. A specimen settled on grass; across the sun, wings closed. It was disturbed by a ♂ *E. janira*, it settled again and this time oriented and closed its wings, making no shadow.

Same place and day. A ♂ settled on a leaf, oriented wings open.

Same place and day. A ♂ seen to settle three times on leaves, with wings open; twice it faced the sun and then partially adjusted itself; the third time it oriented correctly.

* Trans. Ent. Soc. Lond., 1906, pp. 98, 99.

- Same place and day. A ♂ settled on grass, oriented, wings half to fully open.
- Same place and day. A ♀ on a bramble leaf, oriented, wings three-quarters to fully open: it was twice observed to close its wings leaving little shadow; the eye-spot on the fore-wing was exposed.
- Same place and day. A ♂ on a leaf of *Heracleum*, wings three-quarters open, oriented; it momentarily closed its wings, leaving no shadow.
- Same place and day. A ♂ on a bramble leaf, oriented, wings three-quarters open.
- Same place and day. A ♂ on a bramble leaf, wings quite open, imperfectly oriented.
- Same place and day. A ♀ twice seen settled across the sun, wings closed, but eye-spot visible.
- Mortehoe, 22 August, 1907. A ♀ oriented, wings three-quarters open.
- Mortehoe, 24 August, 1907. A ♂ half-oriented.
- Same place and day. A ♀ on a leaf, imperfectly oriented.

Epinephele hyperanthus, Linn.

This is a restless butterfly, and takes long to settle; however, I have this note:—

Mortehoe, 20 July, 1906. Four *E. hyperanthus* seen to orient, with wings three-quarters open.

§ 10. "List" and Shadow.

In my paper on some Rest-attitudes of Butterflies, I gave instances of Satyrine butterflies which usually close up their wings when settled and have a habit of then leaning over to one side. This I termed a "list." The object of the manœuvre appeared to be to aid concealment, but my first observations were imperfect in the important respect that the direction of the list, whether towards or away from the sun, was not recorded. The fact of listing was observed by me in India and Japan, and by Dr. Dixey and myself in England and South Africa.*

To the "listing" butterflies I am now able to add, from my own observations, a Neotropical species, also belonging to the *Satyrinæ*.

* Trans. Ent. Soc. Lond., 1905, pp. 135, 136; also 1906, pp. 109-111.

Calisto zangis, Fabr.

This is quite a shade-loving butterfly; it keeps close to the ground flying amongst herbage, usually for a very short distance at a time. It was once seen flying freely on a rainy day.

Mackfield, Jamaica, 29 January, 1907. Three *C. zangis* seen to settle (one of them twice) with a list away from the sun of about 30° (from the vertical).

Christiana, Jamaica, 2 February. *C. zangis* seen to list away from the sun.

Mile Gully Mt., Jamaica, 14 February. *C. zangis* seen to settle and then, with a jerk, list about 30° .

Port Antonio, Jamaica, 4 March. Three *C. zangis* seen to list from the sun, usually but 20° – 30° ; one was seen to increase the list in two movements.

During my visit to Ceylon in the spring of 1908 I did not see any butterflies list.

Cænonympha pamphilus, Linn.

Early in June 1906 Mr. W. J. Kaye told me that he had recently noted in Surrey the common *C. pamphilus* settle with its wings up, but leaning over in such a way that the sun's rays fell vertically upon its wings. Going down to Devonshire the next day I naturally wished to confirm Mr. Kaye's observation, but though I have seen the butterfly in some abundance at Mortehoe its appearance there is most uncertain, so much so that neither in 1904 nor in 1907 did I come across a single specimen in the parish! However, in 1906 I did succeed in finding three specimens which I observed with the following results.

Mortehoe, 10 June, 1906. *C. pamphilus*: a specimen seen to settle six times; always across the sun; with head sometimes to the right, sometimes to the left; the wings up; in every case with a list away from the sun so that its rays were about normal to the wing surface.

Mortehoe, 13 June, 1906. A specimen seen to settle several times; across the sun; the wings up, but with no list.

Mortehoe, 14 June, 1906. A specimen seen to settle 16 times; always with wings up and across the sun; on 12 occasions with a list away from the sun.

Braunton Burrows, 10 Sept., 1907. *C. pamphilus* (the only one seen that year) settled across the sun, with head to the wind, and a list away from the sun.

Morte Point, 5 September, 1908. *C. pamphilus* rather common at one spot; the wind was so strong as to compel them to keep their heads to it regardless of the sun. A specimen was seen to list three times to the right, slightly, and once to the left, strongly.

Satyrus semele, Linn.

The behaviour of this butterfly may be compared with that of the last-named.

Mortehoe, 20 July, 1906. A number of *S. semele* observed to settle. All put their wings up; two oriented with tail to sun; one faced the sun; 24 placed themselves across the sun, of these one was noted as listing about 30° towards the sun, but eight listed away from the sun, only one however to an extreme degree.

Same place and day. Three *S. semele* put into a large glass-covered box. Observed the same afternoon, at 6 p.m., in sunlight; all three were sitting across the sun and listed away from it 35° , 45° , and 55° respectively.

Mortehoe, 31 July, 1906. Several *semele* noted, settled across, and tilted a *little* away from the sun.

Mortehoe, 22 August, 1907. Three *semele* observed at rest, all across the sun and listed away from it 30° , 40° , and 25° respectively.

Lundy Island, 27 August, 1907. A *semele* listed away from the sun about 50° .

Here I may insert an observation made by Mr. E. G. Waddilove at Bournemouth in the autumn of 1906 :—

“A grayling settled on a patch of bare black peat-earth, shut up its wings vertically and crawled at once some two yards to the edge of the patch to where some fir-needles, a cone or two, and a few brittle twigs were lying, and then becoming stationary threw itself over at an angle of some 45° square to

the sun. It thus became quite indistinguishable from its surroundings." (From a letter to the author.)

The late Mr. C. G. Barrett, in an admirable account of the habits of the same butterfly, wrote as follows :—

" . . . it even seems to lie down sideways, or at any rate to so greatly slope its closed wings as to appear prostrate." *

Epinephele janira, Linn.

The case of our commonest butterfly is especially interesting, since its habits are irregular and partake of those of *C. pamphilus* and *S. semele*.

Mortehoe, 20 July, 1906. *E. janira*. Four specimens oriented; of these, 3 had the wings open, 1 closed. Eleven specimens were settled across the sun, with wings closed; certainly one of the latter listed from the sun.

July 30. Some noticed to orient; others sitting across the sun.

Mortehoe, 11 August, 1907. 1 ♂ and 2 ♀ oriented; wings three-quarters open. Others seen across the sun and one of these listed. The wind was however this day too strong for trustworthy observations. The butterflies mostly sat head to the wind.

Mortehoe, 15 August, 1907. Several specimens noted settled on grass, on or near the ground. Of these 3 ♂ oriented, 1 with the wings quite open, the other 2 three-quarters open. A ♀ oriented with the wings open; another ♀ settled on a leaf oriented with the wings three-quarters open. Another ♀ sat across the sun, had its wings up, and listed away from the sun. The eye-spot on the fore-wing sometimes obscured, sometimes in part visible.

Mortehoe, 16 August, 1907. A ♀ seen to settle three times across the sun, with its wings closed, leaning away from the sun. Yet another ♀ was seen to settle three times; twice across the sun, with wings closed, but on the third occasion with its wings open and fairly oriented.

* "Lepidoptera of the British Islands," 1893, vol. i, p. 35.

Mortehoe, 22 August, 1907. A ♀ observed to settle three times, (1) oriented; (2) across, with slight list away from the sun; (3) oriented.

August 24. A ♀ settled on a leaf oriented.

The effect of a list on the shadow.

It is worth while carefully considering the precise effect of a list on the shadow of a butterfly sitting with the axis of its body at right angles to the sun's rays.

To make the matter clear I have constructed three diagrams. The diagrammatic butterfly is in each case

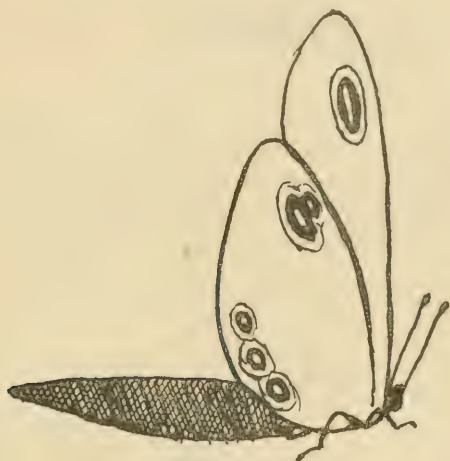


DIAGRAM A.

Butterfly upright, sun's elevation 50°.

supposed to be settled with its tail towards the observer, but turned somewhat to the left so as (in two of the three diagrams) to expose the underside of the right wings obliquely to the observer. The sun is supposed to be to the right of the observer and nearly to the right of the butterfly. The sun's elevation is taken to be 50°, representing a condition of affairs that is fulfilled in Europe during some part of every day near midsummer, and in the tropics during some part of every day in the year.

When the butterfly is upright its shadow is nearly as long as its wings, moreover its shadow is fully exposed to view. (See diagram A.)

If the butterfly were to list towards the sun its shadow, still fully exposed to view, would diminish until the list were equal to the sun's altitude, when there would be no shadow. In this position, moreover, its wing surfaces would be least illuminated.

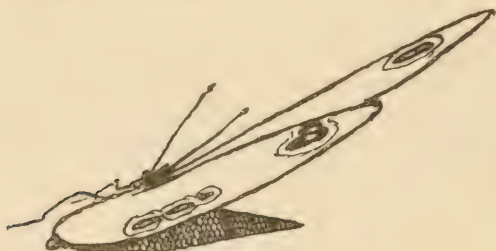


DIAGRAM B.
Butterfly listing, more than 60° towards the sun.

Supposing the butterfly to increase its list; this would bring the sun's rays on to the under surface of its left wings and so throw the shadow to the right, or towards the sun. (See diagram B.) The shadow would continue to

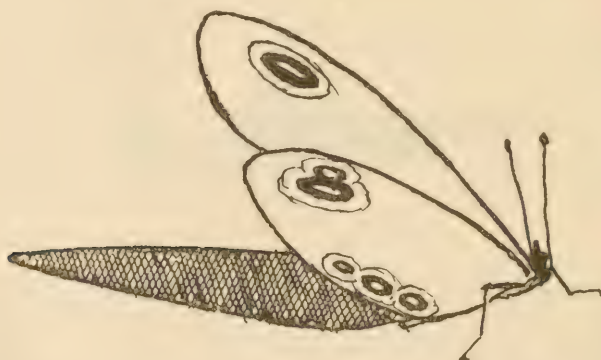


DIAGRAM C.
Butterfly listing, 40° from the sun.

increase in length until when the butterfly's wings touched the ground it would equal them in length. On the other hand, as the shadow increased in length it would be more and more concealed from view.

But as a matter of fact the list has almost always been observed to be *away* from the sun. Such a list increases

the length of the shadow until the list amounts to 40° (under the conditions assumed) and so brings the wings into a position normal to the sun's rays. (See diagram C.) The length of the shadow is then at its maximum and longer than the wings.

A further list will diminish the shadow until when the wings touch the ground it will equal their length.

A little consideration will, however, show that by listing the butterfly, so to say, covers up its own shadow more and more, so that while a slight list produces little effect on the shadow, a considerable list— 45° and upwards—makes the shadow less conspicuous than that cast by the same butterfly in the upright position.

My conclusion accordingly is that, so far as regards the shadow cast, no list *from* the sun can be protective to the insect unless it be extreme. Again, a list *from* the sun, by resulting in the maximum illumination of the wing surface, can hardly aid concealment. At the same time, it cannot be denied that a butterfly by placing itself out of the upright, may thereby be protected in so far as it may then be more difficult to detach it from its surroundings. This would certainly appear to have been the case with the *Melanitis* recorded by Col. Bingham* and by "E. H. A.,"† also with the *S. semele* observed by Mr. E. G. Waddilove.

Dr. Chapman tells me that he has observed a marked list in a Spanish species of *Erebia*, and my own experience of list is confined to the Satyrines, a group of feeble fliers, be it noted, with (at any rate in the great majority of species) cryptic under-sides. I am, however, aware that Prof. Poulton and Mr. Rowland-Brown have observed an extreme list in *Thecla rubi*, Linn.; possibly connected with the green colour of the under-surface of its wings.‡

Barrett's remark as to a rarer British butterfly, *Grapta c-album*, Linn., deserves quotation:—

"... fond of sunning itself in roads, on warm walls, or on the ground upon dead leaves in sheltered valleys. Here if the sun becomes overclouded, it will sometimes close its wings and almost lie down, in such a manner that, to distinguish its brown and

* Trans. Ent. Soc. Lond., 1902, p. 363. See also "Butterflies of India," vol. i, p. 47. † "A Naturalist on the Prowl," p. 203.

‡ Proc. Ent. Soc. Lond., 1906, p. xxviii.

green marbled underside from the dead leaves is almost impossible." * Here Barrett says *if the sun becomes overclouded*, but I have observed the list during bright sunshine only.

When my attention was first drawn to the subject of Heliotropism by observing the habits of *Pararge schakra*, Koll., in the Simla district in October, 1903, I was disposed to associate that habit with another—that of listing to one side or the other—and suggested that both had probably been selected since they appeared to assist to a notable degree in the concealment of the insect from its foes.†

The evidence now available is more ample though still far short of what would be requisite in my opinion to establish definitely any explanation.

Prof. Parker's explanation that by negative Heliotropism the insect displays its colouring to the best advantage, can scarcely be applied to list, for while it may be true that by listing a butterfly displays its under-side, that under-side is in listing butterflies usually cryptic, even when in our cabinet it appears the more brilliant of the two. Moreover, in the listing position the most conspicuous feature of the pattern is often concealed by the hind-wing.

That under special circumstances there is an "economy of shadow" in both heliotropic and listing butterflies is unquestionable. On the other hand, the negatively heliotropic butterfly with wings expanded, and the listing butterfly with wings closed, both place their wings as nearly as may be normal to the sun's rays, exposing in the one case their upper, in the other their under, surface. Is it possible that the direct rays of the sun falling normally on either surface of the wings, afford a pleasurable sensation to the insect? Or is the exposure of the insect's *body* to the sun, common to some extent to both these attitudes, the end obtained? The obvious love of most butterflies for hot and sunny corners unquestion-

* *Op. cit.* p. 125.

† Mr. Marshall writes to me that he has observed in the case of three S. African butterflies, *Precis cebrene* and *Hamanumida dædalus*, at Salisbury, and *Mycalesis campina*, Auriv., in Chirinda forest, that when they have been sunning themselves they have closed their wings with a snap when a heavy cloud has passed over the sun.

ably suggests some such explanation. Perhaps the two explanations may both be true, that heliotropism and list combine the pleasures of insolation with the minimum of risk.* It must, however, be remembered that the listing butterfly exposes to the sun *one* hind-wing only, and a small portion of one fore-wing.

§ 11. *The inverted attitude of Lycænids and some other Butterflies.*

Supplementing the observations recorded in my paper on "Some Rest Attitudes of Butterflies"† I may add the following notes:—

North Devon, 1 September, 1907. Walking with Mr. H. Champion along the Woolacombe Sandhills late in the afternoon we observed 39 specimens of *Lycæna icarus*, Rott., asleep on Marram, Privet, etc. No less than 38 of these were sleeping with the head down, while the exceptional one was horizontal. In many cases the fore-wings were drawn so far back that the costæ of the hind-wings overlapped those of the fore-wings. The antennæ were porrected and near together.‡

Mortehoe, 11 September, 1907. A ♀ *L. icarus* at rest on a Ragwort flower moved its hind-wings alternately.

* Mr. Marshall calls my attention to the fact that orienting butterflies are always very much on the alert, and do not need cryptic protection.

† Trans. Ent. Soc. Lond., 1906, pp. 106-9.

‡ In the fourth Report of the Rugby School Natural History Society, 1870, p. 17, is an interesting note by Mr. Arthur Sidgwick, which I give at some length as the Report is not easily accessible. "On the 13th August, 1870, I noticed on the road from Bex to Gryon, in the Rhone Valley, a large number of the Chalk-hill Blue (*Polyommatus Corydon*), on the umbelliferous plants by the roadside. It was just sunset, and they were all at rest. Their colour and shape effectually protected them from notice. . . . I noticed that they all rested *head downwards*. It occurred to me that even this apparently trifling detail of instinct or habit might be protective. The eye in wandering over a plant is arrested more easily than one would suppose by any outline *out of accord* with the general lines on which the plant is constructed." The note is accompanied by sketches showing that the butterfly resting head downwards is less conspicuous than one in the opposite position.

Caracas, Venezuela, 3 March, 1907. The dingy little *Catochrysops hanno*, Stoll., was seen sitting head downwards, opening its hind-wings at intervals.

Walderston, Jamaica, 16 February, 1907. *Calycopis pan*, Drury. The lobe of the hind-wing is everted as in *Aphnæus*, *Argiolaus*, etc.

St. Ann's, Trinidad, 1 April, 1907. A ♀ of *Thecla spurius*, Feld., seen sitting head down; the hind-wing is folded; the lobe is large.

The Zebra-like *Thecla linus*, Sulz., is a common species in Trinidad. The lobe of the hind-wing is everted, but not quite to a right angle; it is curious that the tails are *crossed*, so that the tail of the right-wing imitates the antenna of the left side and *vice versa*. Mr. Knight has made this very clear in the figure.



FIG. 1.

Thecla linus at rest : (a) natural size; (b) the lobe enlarged.

The tails were seen to move slightly, and the "false head" looked more like a head than the real one. Though I have no note to that effect, I feel sure that I saw this species sitting head downwards.

My recent Ceylon experience (Jan.-March, 1908) enables me to add 9 more species, in which I have observed the inverted attitude, making in all 19 species of *Lycænidæ*. It seems probable that sufficient observations are alone required to prove the habit to be general in that family.*

* Compare Trans. Ent. Soc. Lond., 1905, pp. 85, 86, 127. Mr. Marshall writes : " I am quite satisfied that this (head down) is the usual position in *Lycænidæ*, and could add numerous species to your list, such as : *Aphnæus*, *Spindasis*, *Axiocerces*, *Iolaus*, *Stugeta*, *Hypolycæna*, *Mimacræa*, *Nyrina*, etc., etc., but the simplest way is to mention the species which do *not* do it. Of these I know three only in South Africa : viz. *Alæna nyassæ*, *A. amazoula*, and *Pentila*

Zizera otis, Fabr., f. *indica*, Murray. ♀. One observation.

Everes parrhasius, Fabr. ♀. Two observations.

Nacaduba atrata, Horsf. ♂. One observation.

N. noreia, Felder. One observation.

Jamides bochus, Cram. ♀. One observation.

Lampides elpis, Godt. ♂. Two observations: in one case it settled head upwards, but turned round immediately.

Lampides celeno, Cram. 10 ♂, 1 ♀.

Polyommatus bæticus, Linn. Both sexes. Nine observations.

Surendra quercetorum, Moore. ♀. One observation.

Loxura arcuata, Moore. One observation.

The "sawing" movement of the hind-wings observed at Kallár in the Nilgiris in 1904 in *Lampides* sp., and in *Tarucus telicanus*, Lang, at East London, S. Africa, in 1905, was again observed in several Blues in Ceylon in 1908, viz. :—

Telicada nyseus, Guér. Six observations.

Everes argiades, Pall. Two observations.

Lampides celeno, Cram. Three observations.

Polyommatus bæticus, Linn. Six observations.

Poulton explains this movement* as assisting in the deception of the "false head," but the explanation scarcely satisfies me since butterflies at rest do not usually move their antennæ. It is however possible that movement as movement may challenge attack; compare the case of the Maina mentioned above.†

As regards the lobes on the hind-wings of so many Lycænids the following facts may be noted as supplementary to previous papers.‡

Aphnæus (*Spindasis*) *vulcanus*, Fabr. Ceylon, 1908.

tropicalis—all distasteful species. Similarly this is the normal position in South African *Nymphalinx*, viz. *Atella*, *Lachnoptera*, *Hypanartia*, *Precis*, *Catacroptera*, *Crenis*, *Charaxes*, *Euralia* and *Salamis*, which are all the genera I can think of at the moment in which I have actually observed it. On the other hand, all the *Danaïnx* and *Acræinx* hang with wings down. It is possible this may prove to be a good criterion of palatability, for the head-down position gives the insect a much better opportunity of launching into a rapid flight, and thus evading attack, which is not of such great consequence to distasteful species."

* "Essays on Evolution," 1908, pp. 282, 325, and the references there given.

† p. 630.

‡ Trans. Ent. Soc. Lond., 1905, pp. 85, 86; also 1906, pp. 106-109.

In this species, which has a habit of curvetting rapidly about before settling on the ground, the lobes, which are small, are everted. The hind-wings are folded in such a way as to make a very slight convexity between the two tails, the nervures corresponding to the latter lying in re-entrant angles.

Rapala lazulina, Moore. Ceylon, 1908. The lobes are everted.

Loxura arcuata, Moore. Ceylon, 1908. This species has a peculiar darting flight. The arrangement of the wings at rest is somewhat complicated: the lobes, which are small, are $\frac{1}{2}$, or perhaps $\frac{3}{4}$, everted, showing an eye-spot when the insect is looked down upon from above; the long tails appear to be somewhat twisted—one overlying the other, their black and white tips curved upwards. The

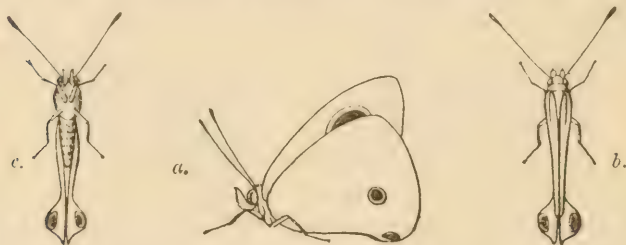


FIG. 2.

Calisto zangis at rest: (a) side view, (b) from above, (c) from below.

portion of the hind-wing between the extremity of the abdomen and the lobe is bent inwards. As touching the very nearly allied Indian species, *L. atymnus*, Cram., I noted at Calcutta in 1903, "its wings are much plaited longitudinally, and when at rest its extremely long tails, crumpled look, and brown colour give it quite the appearance of a dead leaf."*

Neither the inverted attitude nor the everted lobe would appear to be confined to the *Lycanidae*, as the following examples prove.

The common Jamaican Satyrine, *Calisto zangis*, Fabr., has a peculiarity of construction which appears significant. The anal angle of the hind-wing is somewhat produced, moreover on either under surface, at the angle, there is a small ocellus. When at rest the wings are raised over the back in the usual manner; the abdomen is covered by the

* Trans. Ent. Soc. Lond., 1905, p. 90.

hind-wings, which are folded closely under it, but the anal prolongation of the wing is everted at right angles, as in the lobed *Lycænids*, and as in their case the ocellus may be seen from above. In every case in which I noted the butterfly at rest it was upon the ground, so that I do not know whether it ever adopts the inverted attitude and is protected by a "false head." But whether that be so or not the approach to *Lycænid* structure in a *Satyrine* is interesting.

At first I thought that the eversion of the lobe in *C. zangis* might be due to the pressure of the curved surface of the pill-box in which the butterfly was confined, but subsequently was abundantly convinced that such is not the case, for when the butterfly rests on a flat surface with which the wing does not come in contact it is everted just the same.

There is a well-developed lobe in the Oriental and Ethiopian Nymphaline genus *Cyrestis*, while the allied Neotropical genus *Megalura* has a somewhat similar structure (pointed out to me by Prof. Poulton), but I am not aware that the bionomic significance of these has as yet been worked out.

The fine large blue-grey Nymphaline *Peridromia feronia*, Hübn., is a strong flier, which has the unusual habit of settling upon tree-trunks, usually choosing palms with silvery-grey stems. The butterflies harmonise wonderfully with the silvery-grey stems as they sit with wings fully expanded like Geometers, but always *head downwards* as noticed by Darwin in Brazil.* When disturbed they will return to the same tree again and again. I met with this species at Colon, La Guaira and Trinidad, and noticed these points on each occasion.

Another large Nymphaline which appears invariably to sit head downwards is *Aganisthos orion*, Fabr., of which I saw several in Jamaica. The favourite resting-place seemed to be the trunk of a logwood tree, *Hæmatoxylon campeachianum*, Linn., from 1 to 4 feet from the ground. This species rests with its wings closed above its back, and although the underside is cryptically coloured, the butterfly may be seen from a considerable distance when in profile.

* "Journal of Researches," etc., edn. 1860, p. 33. Compare W. J. Burchell's observations (1825—1836), quoted by J. C. Moulton, Ann. Mag. Nat. Hist., Ser. 8, vol. ii, August 1908, pp. 184—7.

The pretty little Nymphaline *Dynamine thescus*, Feld., which I was familiar with in Venezuela, Trinidad and Tobago, often reminded me of a *Lycænid* in its rapid flight and other ways; thus I several times saw it settle head downwards and then quickly move its wings, though I was not able to get near enough to make out the exact nature of the movement.

§ 12. *The Rest-Attitudes of certain Neotropical and Oriental Hesperids.*

The attitudes assumed by the following Skippers are doubtless familiar enough to many who have seen them



FIG. 3.

Eudamus proteus at rest: (a) side view, (b) from above.

alive, but nevertheless I think it worth putting them on record, more especially since even such excellent illustrations as those of Plötz represent these insects at rest in positions that they never assume.

Eudamus proteus, Linn. The rest-attitude of this common species, as seen in Jamaica, is very striking. It was noted to rest with all the wings up, but partly open and with the fore-wings much sloped back. At the same time the conspicuous tails remain horizontal, nearly at right angles to the wings; for a great part of their length they overlap, but their extremities are divergent. If Mr. Knight's drawings do not represent this attitude quite as clearly as I should have liked, it is because I was not able

to supply the artist with adequate material. The tails appear to be an impediment to the insect's flight.

The three following species, *Hesperia syrichthus*, Linn., *Anastrus simplicior*, Möschl., and *Ephyriades otreus*, Cram., all rest with the wings fully expanded.

On the other hand, *Carystus coryna*, Hew., and *Catia drurii*, Latr., rest with all the wings up; in the case of the latter the fore-wings are much sloped back. The only specimen of the former that it has been my good fortune to see alive was resting on a mass of silvery-white schist or gneiss which shone in the sun with the same metallic gleam as its "silver-washed" under-side.*

Cymænes silius, Latr., was noted in Tobago to settle with the hind-wings horizontal, the fore-wings raised.

In four species I have noted that the fore-wings (which are somewhat ample) are convex upwards as in our English *Thanaos tages*, Linn., these are: *Gorgythion begga*, Prittw.; *Cycloglypha thrasybulus*, Fabr.; and *Chiomara gesta*, H.S., all met with in Venezuela, and *Systacea crosa*, Hübn., in Jamaica.

Mr. Meyrick includes our *malvæ* and *tages* in the genus *Hesperia*; but the difference in the form of the fore-wings is very obvious during life, as is the difference in the resting attitudes, and the distinctions seem to me to have generic value.

I have noted the folding of the hind-wings in the following Ceylon Hesperids:—*Telicota bambusæ*, Moore; *Parnara mathias*, Fabr.; *Bibasis sena*, Moore, and *Badamia exclamationis*, Fabr.†

Two of the above-named rest with the fore-wings erect, the hind-wings erect, or nearly so, and all the wings much sloped back:—*Parnara mathias* and *Badamia exclamationis*.

The following Ceylon species settle with their wings fully expanded like Geometers:—*Tagiades obscurus*, Mab. (*distans*, Moore); *Caprona* (*Pterygospidea*) *ransonetti*, Feld.; *Hantana infernus*, Feld.; *Celænorrhinus* (*Plesioneura*) *spilothyrus*, Feld. Of these the two last certainly settle on the under-side of leaves; they are neither of them so swift of flight as many of the family, and there is no doubt whatever that the habit greatly aids the concealment of somewhat conspicuous insects. When in Ceylon previously,

* Entom. Month. Mag., 1908, p. 120.

† Compare Trans. Ent. Soc. Lond., 1906, p. 112.

in 1904, I saw *spilothyrus* thus settle, and in the same year in India saw *ransonnetti* do so.*

Though perhaps somewhat out of place I append the beautiful drawing made by Mr. H. Knight (from my sketch and specially set specimens) to illustrate the very peculiar attitude adopted by the common Jamaican Uraniid, *Sematura xgistus*, Fabr. The hind-wings are somewhat fluted, as in *Pararge xgeria*, Linn., the anal angle of the hind-wings is *inverted*, not everted as in the Lycænids. One might naturally suggest as a possible explanation a procrptic resemblance to a dead leaf, but

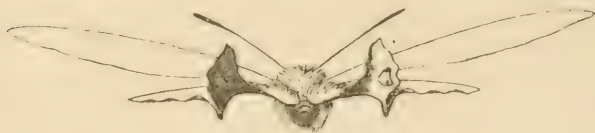


FIG. 4.

Sematura xgistus at rest, viewed from behind.

the only specimens that I have seen at rest were inside houses whither they had been attracted by light.

§ 13. Seasonal Dimorphism in Neotropical Butterflies.

Seasonal Dimorphism has long been a subject of study in the Oriental and Ethiopian regions, but in the Neotropical world comparatively little attention has been paid to it.† A visit of less than four months, and those within the limits of the winter, or dry-season, affords but little opportunity for the investigation of such a difficult question—and the difficulty is increased by the paucity of cabinet specimens bearing adequate data—nevertheless I venture to offer the results of my observations for what they may be worth.

In the Old World we see in certain genera of the Satyrines that the same species exhibit two forms, characterised by the presence or absence of ocelli on the under surface of the hind-wings. Similarly two forms are met with in the Nymphaline genus *Precis*‡; in the one ocelli on the under side of the hind-wings are well de-

* For the similar habit of *Pterygospidea* (*Tagiades*) *flesus*, Fabr., in S. Africa, see Trans. Ent. Soc. Lond., 1907, pp. 323, 330.

† See *Dixey*, Proc. Ent. Soc. Lond., 1898, p. xxxix.

‡ Including *Junonia*.

veloped, but in the other they are rudimentary or entirely absent. With the absence of ocelli is often associated a more angulated form of the wings, which are sometimes tailed, while the whole under surface is often of a redder colour, and the insect when at rest is cryptic, sometimes resembling a dead leaf. Again, in many Pierines there are also two forms, the one characterised by the black markings on the upper surface being more pronounced and sometimes by a suffusion or irroration of black scales; whereas in the other form there is an irroration of reddish scales on the under surface, with or without reddish or purplish markings.* Now these two forms have long been recognised as occurring for the most part in the Wet and Dry seasons respectively, though it must be admitted that in the case of *Terias* and *Catopsilia* the correspondence is not nearly so close as in *Mycalesis*, *Precis* and *Teracolus*. However, for convenience these are usually spoken of as "Wet-season forms" and "Dry-season forms," or even for shortness as "Wet" and "Dry."

When at rest, with wings closed above its back, the Dry-season insect is usually more cryptic than the Wet, resembling in some instances red soil, in others a dead or discoloured leaf. It is notable that the Dry-season form is commonly more marked in the female sex.

If among Neotropical butterflies similar pairs of forms are met with, I propose provisionally to speak of them as "Wet" and "Dry," and then to inquire to what extent they are found in the corresponding seasons of the year.

Calisto zangis, Fabr. (Jamaica). Although there is some variation in the size of the ocelli on the under side of the wings in my specimens, I am unable to divide them into seasonal forms.

Euptychia hermes, Fabr., *camerta*, Cram. In the Wet-

* In *Catopsilia*, *Callidryas* and *Ixias* the disco-cellular spots on the under side of both fore- and hind-wings are usually larger with larger white centres and altogether more conspicuous in the dry season. Moreover, in *Ixias* dry-season specimens have on the under side of the hind-wing a series of reddish, or purplish, post-discal spots, which when fully developed have white centres (especially in *I. pyrene*), and call to mind the similarly placed ocelli so well known in the Wet-season forms of *Mycalesis* and *Precis*, and indeed they are not unlike the rudimentary ocelli seen in "intermediate" specimens of those genera, though they never attain to the complicated "peacock-feather" pattern so characteristic of many *Nymphalidæ*.

season form the ground colour of the under-side is of a bluish-grey, the transverse lines are distinct and the ocelli well marked.

In the Dry-season form the ground colour is browner in tint, the transverse lines are faint and the ocelli are minute.

I give, in a tabular form, a statement of all the specimens that I took, divided into the three classes "Dry," "Wet," and "Intermediate." The specimens classed as intermediate I have attempted to divide according as they seem to approach nearer to one form or the other. Males and females are distinguished and the dates of capture given.

Euptychia hermes, Fabr., *camerta*, Cram.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Trinidad . .	...	...	♂	19 Dec.
Panama . .	...	...	♂	28 Dec.
Venezuela . .	♂ ♂ ♂ ♀ ♂	♂ ♀	♂ ♂ ♂ ♀	22-29 March.
Trinidad . .	...	...	♂ ♀	1 April
Tobago . .	...	...	♂ ♀ ♀ ♀ ♂	6, 7 April.
Trinidad . .	...	...	♂ ♂	12 April.
Totals. .	4♂, 1♀	1♂, 1♀; 4♂, 1♀	6♂, 5♀	

It is somewhat remarkable that the specimens from Tobago were all distinctly "Wet" though the country showed every sign of extreme drought. Here the distinction between the forms might be local and not seasonal; or, as I am disposed to think, a seasonal form may have become localised.

Precis lavinia, Cram. The nomenclature of this species is in great confusion. Messrs. Godman and Salvin brought together the various forms found in Central America under the name *cania*, Hübn., including what is generally known in the West Indies as *genoveva*, Cram. Mr. Guy A. K. Marshall has recently rearranged the genus *Precis* in the National Collection, and I am happy to find myself in complete agreement with one whose knowledge of the genus is so intimate. Cramer figured three forms, all from Surinam; a ♂ which he called *lavinia*, a ♀ which he called *evarete*, and a ♀ which he called *genoveva*. The last two I agree with Mr. Marshall in considering to be Dry- and Wet-season forms respectively. The insect is

extremely variable, in ground colour, in the size of the ocelli on the upper surface (especially the anterior ocellus on the hind-wing), in the presence or absence of a greenish gloss, or "glance," and in the presence or absence of a transverse white band on the fore-wings (*zonalis*, Felder). In some specimens from Guiana this white band is replaced by a purplish gloss. It is almost impossible to divide these varieties into local races since the various forms overlap considerably, and the most widely different forms are found in Mexico. However, speaking generally, it may be said that the form *cænia*, Hübn., prevails in the United States and northern Mexico, that the form *zonalis*, Feld. (*genoveva*, auctorum) prevails in the West Indies (approaching to *cænia* in the Bahamas), that the type form *lavinia*, Cram., of which the ♂ has a hind-wing with a green gloss, prevails in Brazil, a brown form in Peru.

But what does not seem to have been generally noticed is that all the numerous varieties are themselves dimorphic. That is to say, that (as in the Indian species of *Precis*) they may be divided, as regards the colouring of the under surface of the hind-wings, into (1) those with several ocelli, of which two at least are conspicuous, (2) those in which the ocelli are merely indicated by black dots, or are entirely wanting, and (3) individuals intermediate in this respect. Analogy with the East would lead one to call the first *Wet-season* forms and the second *Dry-season* forms.

Precis lavinia, Cram.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Barbados	♀	...	♂	19 Dec. 1906.
Mt. Hope, Panama	...	...	♂	28 Dec. 1906.
Constant Spring, Jamaica . . . .	...	♂	♂ ♀ ♀	31 Dec. 1906— 8 Jan. 1907.
Mandeville, Jamaica	♂	...	...	20 Jan. 1907.
Port Antonio „	...	♂	♂	25 Feb. 1907.
Constant Spring, Jamaica . . . .	♂	...	...	7 March 1907.
Panama City . .	♀ ♀	...	♀	12 March 1907.
Caracas, Venezuela	♂ ♂ ♂	...	♀	19–28 March 1907.
St. Ann's, Trinidad	...	♂	...	1 April 1907.
Tobago	♂	♂	...	6–8 April 1907.
Total . . .	7 ♂, 2 ♀	4 ♂	4 ♂, 4 ♀	

I brought home 21 specimens; of these 6 were taken between 18 Dec. and 8 Jan., 5 of them were "wet," only 1 "dry."

Fifteen were taken between 20 Jan. and 9 April; of these 8 were "dry," 3 "wet," and 4 intermediate.

As the dry season advanced the dry form more or less displaced the wet form.

Dated specimens in Mr. W. J. Kaye's collection taken in the wet season are mostly wet; the same applies to specimens in the Hope Collection. Judging from the condition of many of the specimens I met with, it is a long-lived insect and therefore considerable overlapping may be anticipated.

Anartia jatropha, Linn. Two forms are fairly well marked:—

Wet-season. Under side. Ground colour nearly white; markings often conspicuously edged with scarlet. Ocelli black with blue centres. No transverse bar on hind-wing.

Dry-season. Under side. Ground colour shaded with grey; markings edged with ochreous or reddish-brown, ocelli often blue only, orange-ringed. Hind-wing with a transverse grey bar.

Anartia jatropha, Linn.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Trinidad. . .	...	...	♂	19 Dec.
Panama . . .	...	♀	♀ ♂ ♂	28 Dec.
Constant Spring	♀ ♀ ♀		♂ ♂	31 Dec.—5 Jan.
Mandeville . .	♂	♂	♂	20, 21 Jan.
Mackfield . .	♂	♂	...	24 Jan.
Christiana . .	♂	...	...	16 Feb.
Port Antonio .	♀ ♀	♀ ♂	...	24 Feb.—4 Mar.
Panama . . .	...	...	♂	12 March.
Trinidad . .	...	...	♂	1 April.
Tobago . . .	...	...	♂ ♂ ♂	4-5 April.
Total . . .	3 ♂, 5 ♀	3 ♂, 2 ♀; 3 ♂, 1 ♀	9 ♂	

The table would appear to point to the forms being local rather than seasonal. The "dry" specimens, it will be observed, were all taken in Jamaica and were all of the race, or sub-species *jamaicensis*, Möschler,* but, on the other hand, not all the *jamaicensis* were "dry."

* See "Butterflies taken in Jamaica," Trans. Ent. Soc. Lond., 1908, p. 44.

Callidryas eubule, Linn. The two forms are abundantly distinct, more especially in the male sex.

Dry form. ♂ *Under side.* Hind-wing, and all exposed part of fore-wing, irrorated with red-brown; the markings strong; stigmata clearly outlined.

♀ *Under side.* As in male but reddish irroration darker.

Wet form. ♂ *Under side.* No irroration: brown markings very faint; stigmata faintly outlined.

♀ *Under side.* Reddish irroration very faint.

Intermediate specimens are frequent, approaching now one, now the other form.

It may be at once admitted that these two forms of *C. eubule* are not restricted to the respective seasons to anything like the extent that is observed in the case, *e.g.*, of the S. African *Precis octavia*, Cram., and its "dry" form *P. sesamus*, Trim. Thus on 12 Jan., 1907, *C. eubule* was seen in numbers flying about a weedy field at Temple Hall, on the road between Constant Spring and Castleton, Jamaica. Three examples were secured; a female of well-marked "dry" and one of equally well-marked "wet" type, whereas the third, a male, may be described as "intermediate, inclining to wet." I was informed that there had been no rain for three weeks.

Callidryas eubule, L.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Barbados . . . .	...	♀ ♀	♂ ♂	18 Dec. 1906.
Trinidad . . . .	...	...	♂	19 Dec. 1906.
Savanilla, Colombia	...	...	♂ ♂	22 Dec. 1906.
Cartagena " "	...	♀	♂	23 Dec. 1906.
Colon, Panama . .	...	...	♂	28 Dec. 1906.
Constant Spring, Jamaica	♀	♂	♂ ♂	1-9 Jan. 1907.
Castleton, Jamaica .	♀	♂	♂	11-12 Jan. 1907.
Mackfield " "	♂ ♂ ♂ ♂	♀	♀	25-27 Jan. 1907.
Montego Bay " "	♂ ♀ ♀	♀ ♂	...	4-5 Feb. 1907.
Walderston " "	♀ ♀	♀	♂	7-18 Feb. 1907.
Spanish Town " "	♀	...	♂	21-22 Feb. 1907.
Port Antonio " "	♂ ♂	♂	...	3-5 Mar. 1907.
Constant Spring, Jamaica . . . .	...	♀	...	7 Mar. 1907.
El Valle, Venezuela	...	♂ ♂ ♀	...	26-27 Mar. 1907.
Zigzag " "	...	♂	...	29 Mar. 1907.
Tobago . . . .	...	♂ ♂ ♀ ♀ ♂ ♂ ♀	♂ ♂ ♀	3-10 Apr. 1907.
Totals . . .	7 ♂, 7 ♀	14 ♂, 12 ♀	12 ♂, 3 ♀	

It will be observed that (as we found in the case of *A. jatrophae*) no distinctly "dry" specimens were taken out of Jamaica. There is also evidence (very ambiguous in the case of Tobago) that the "dry" form tended to displace the "wet" as the season advanced.

I had also the advantage of examining Mr. W. J. Kaye's series of this insect. Of six specimens taken in Jamaica in the month of August (wet season) 5 are of the "wet" form, 1 of the "dry." Of two specimens taken in Trinidad in July, one is "wet," the other "intermediate," another taken in September is also "intermediate." A specimen taken in British Guiana in either November or December is "wet."

These facts are fairly in accord with the theory that the dimorphism is seasonal in the case of *C. cubule*, especially if due allowance be made for the fact that the insect has the appearance of being long-lived.

Terias euterpe, Mén. (Jamaica). My 60 specimens exhibit but very trifling differences that can be set down to possible seasonal dimorphism.

The specimens that I am disposed to regard as exhibiting Dry-season coloration may be distinguished by the following characters on the *under surface*.

The reddish-orange edging of the wings is more conspicuous. The hind-wings are irrorated with purplish-brown scales, and the purplish markings (especially the borders of the apical pink patch) are more conspicuous.

I do not give the results as set out in the following table with much confidence, and the division of the "intermediate" specimens into those inclining rather to wet or to dry respectively should not carry much weight. Subject to these limitations, it will be seen that the specimens considered as "wet" were commonest at the two extremities of the period, those considered as "dry" prevailed throughout the first half of February.

Terias euterpe, Mén. (Jamaica).

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Constant Spring	♂ ♂	♂ ♀	♂ ♂ ♂ ♂ ♀	31 Dec.—4 Jan.
”	♀ ...		♂ ♀	8–10 Jan.
Castleton	♀	♂ ♂	♀ ♂	11–12 Jan.
Mandeville	♂ ♀ ♀ ♂	♂ ♂ ♂	♀ ...	17–22 Jan.
Mackfield	♂ ♀	♂ ♀ ♀ ♂ ♂ ♂ ♂ ♂	♀ ♂	24–27 Jan.
”	♀	♂ ♀ ♀ ♀ ♂ ♂	♂	29 Jan.—2 Feb.
Montego Bay	...	♀	...	4 Feb.
Walderston	...	♂ ♀	♂	8–14 Feb.
Christiana	♂	♂ ♂	...	16 Feb.
Walderston	♀	♀ ♂	♀ ♀	18 Feb.
Port Antonio	...	♂ ♀	♂	25 Feb.—1 Mar.
Constant Spring	...	...	♂	7 March.
Total . . .	6 ♂, 6 ♀	20 ♂, 10 ♀; 5 ♂, 2 ♀	7 ♂, 4 ♀	

Terias delia, Cram. (Jamaica, N. Coast of S. America).

The extreme “seasonal” forms are quite distinct.

♂ UPPER SIDE.

Wet-season.

Ground pale yellow; costa broadly black; longitudinal black stripe broad.

Dry-season.

Ground full yellow; costa faintly grey; longitudinal black stripe narrower.

♂ UNDER SIDE.

Wet-season.

Uniformly white.

Dry-season.

Hind-wings and costal three-fourths of fore-wings yellow irrorated with brown.

♀ UPPER SIDE.

Wet-season.

Ground white; costa broadly grey.

Dry-season.

Ground of fore-wing pale yellow extending to costa.

♀ UNDER SIDE.

Wet-season.

Fore-wing white; border pale yellow; hind-wing pale yellow irrorated with grey.

Dry-season.

Fore-wing yellow, its tip and all hind-wing pinkish-orange irrorated with darker.

Terias delia, Cram.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Savanilla, Colombia	...	♀	♂	22 Dec. <i>F. lydia</i> .
Colon, Panama . .	...	...	♂ ♂ ♂ ♂ ♀	28, 29 Dec. <i>F. lydia</i> .
Constant Spring, Jamaica	♂ ♂ ♀ ♀ ♀	♂ ♂ ♂ ♂ ♀ ♂	♂ ♂ ♂	1-8 Jan.
Castleton, Jamaica	...	♀	♂	12 Jan.
Mandeville „	♀	♂	...	22 Jan.
Mackfield „	♀ ♀ ♀ ♂ ♀	♂	♂	24-26 Jan.
Montego Bay, Jamaica	♀	...	♀	4 Feb.
Walderston, Jamaica	♀ ♂	...	...	12 Feb.
Port Antonio, Jamaica . . . .	...	♀	...	25 Feb.
Constant Spring, Jamaica . . . .	♀	...	...	7 March.
Ancon, Panama .	♀ ♀ ♀	♂ ♂	...	11, 12 Mar.
Savanilla, Colombia	♀	...	...	15 March.
Carácas, Venezuela	♀ ♀	...	...	18-25 Mar.
Total	5 ♂, 16 ♀	8 ♂, 3 ♀; 1 ♀	10 ♂, 2 ♀	

An examination of this table shows clearly that the dry form got more prevalent as the season advanced, whereas the wet form disappeared. All the first 7 specimens, taken at Savanilla and Colon, 22-29 Dec., are of the form *lydia*, Felder. The last specimen taken, at Carácas, 25 March, is of the form *persistens*, Butl.

A male taken above Constant Spring, *c.* 1000 ft., on 1 Jan., another male taken a little to the west of Constant Spring, *c.* 500 ft., on 8 Jan., and a male taken near the railway at Panama on 12 March, all approach the form *lydia*, Felder, in having the longitudinal black streak broader than usual. On the other hand, the width of the streak in the form *lydia* varies considerably.

An aberrant male of the dry form taken on the foothills above Constant Spring on 1 Jan. is entirely without the black streak, the orange scales alone marking its position.

Terias clathea, Cramer (Jamaica, Venezuela), appears to be specifically distinct from *delia*, but is certainly very closely allied to it; the females are difficult to distinguish, and some specimens of the male sex not easily separable.

What I take to be the Wet form has the under side irrorated with grey; the Dry form with reddish.

Terias elathea, Cram.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Constant Spring, Jamaica	♀ ?	...	♂	1, 2 Jan.
Montego Bay "	...	♂	...	3 Feb.
Port Antonio "	...	...	♂	3 March.
Caracas, Venezuela . .	...	♂ ♂	...	18-20 March.
Total	1 ♀	3 ♂	2 ♂	

In one of the Caracas specimens the black streak is very faint and might be described as obsolescent, in the other there is no trace of the black streak and scarcely any orange.

It will be observed that this aberration was in both species met with in dry, or somewhat dry specimens, but I scarcely think that it can be considered as the extreme dry form, at all events without more material.

Pieris phileta, Fabr., Jamaica, Venezuela, Tobago. In this species the seasonal differences are well known.

Wet-season form. Under side. Wings white, with but faint traces of yellow.

Dry-season form. Under side. Hind-wing and tip of fore-wing yellow; veins and lines in interspaces brown.

Pieris phileta, Fabr.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Montego Bay, Jamaica .	♂	...	...	4 Feb.
" . . . . .	...	♂	...	5 Feb.
"	♀	"
Walderston, Jamaica . .	♂	...	...	7 Feb.
"	♂	...	"
Venezuela . . . . .	...	...	♂	30 March.
"	♂	"
Tobago . . . . .	...	♂	...	10 April.
"	♂	"
Total	2 ♂, 1 ♀	3 ♂	3 ♂	

Here again the forms seem to depend on locality more than season.

In case any one should desire to examine more closely into the matter I append notes on the weather conditions during the period in which I was collecting.

West Indies, etc., Meteorological Notes.

- 18 Dec. *Barbados*. End of Rainy Season: a shower that morning early. Much rain in November. "Christmas Winds" prevailing.
- 19 Dec. *Trinidad*. "Much rain lately": very wet season: rain that morning; ground wet.
- 20 Dec. *La Guaira*. Muddy streets and the appearance of much recent rain.
- 22 Dec. *Savanilla*. Woods very dry: run-to-seed.
- 23 Dec. *Cartagena*. A dry burnt-up look.
- 27 Dec. *Porto Bello*. Rain all day: also rain the day before.
- 28 Dec. *Colon*. Heavy shower this morning. Very heavy rain reported November and early December.
- 31 Dec. *Constant Spring*. No rain for three weeks: unusually cold at Christmas. Country very dry and run-to-seed.
- 7 Jan. *Constant Spring*. A smart shower.
- 15-16 Jan. " " Trifling shower in the night.
- 16 Jan. *Mandeville*. No rain for eight weeks: vegetation very dry.
- 19 Jan. *Mandeville*. Several showers: cloud most days.
- 21-22 Jan. *Mandeville*. Some rain in the night.
- 24 Jan. *Mackfield*. Reported to have been an exceptionally wet season: heavy rains November and up to 12 Dec.; nothing but trifling rain since; vegetation and soil very dry.
- 25 Jan. *Mackfield*. Rain afternoon and evening.
- 29 Jan. " Rain in early morning.
- 31 Jan. " Two heavy showers this afternoon.
- 2 Feb. *Montego Bay*. Heavy showers about four or five days before our arrival: before then no rain for a fortnight.
- 7 Feb. *Walderston*. No rain since 13 November, except trifling showers 3 Feb.
- 11 Feb. *Walderston*. Rain at dusk and early evening.
- 12 Feb. " Rain afternoon and evening.

- 13 Feb. *Walderston*. Wind and drizzle.
 15 Feb. " Slight rain in afternoon.
 16 Feb. " Heavy shower in afternoon.
 20-23 Feb. *Spanish Town*. Rain while we were there and several showers the previous week.
 24 Feb. *Port Antonio*. "No rain in January: some last week." Another informant, "Very dry up to the time of the earthquake (14 Jan.), frequent showers since."
 24 Feb.-5 Mar. *Port Antonio*. Rained nearly every day or night of our stay. Heavy rain 27 Feb.
 7 March. *Constant Spring*. "A good rain eight days ago, and other showers since the earthquake (14 Jan.); nevertheless everything looked very dry."
 11 March. *Panama*. Country very dry.
 20 March. *Carácas*. I was informed "last year was very wet, up to 25 Jan.; since then it has been our dry season, though there was some rain last week."
 21 March. *Carácas*. Heavy shower late afternoon.
 22 March. " Very heavy rain mid-day and afternoon.
 23 March. *Carácas*. Heavy rain mid-day and afternoon—many hours.
 29 March. *La Guaira*. The road down showed traces of heavy rain within a few days.
 4 April. *Tobago*. Everything very dry, but was informed that there had been "some nice showers at night during March."
 8 April. *Tobago*. Very heavy showers.
 12 April. *Trinidad*. Heavy rain.
 14 April. " A shower.

For assistance in the preparation of this paper I am more especially indebted to Prof. E. B. Poulton, F.R.S., to Dr. F. A. Dixey, to Mr. Guy A. K. Marshall, to Commander J. J. Walker, R.N., M.A., and to Mr. W. J. Kaye, but the valuable services of Messrs. Holland, Hamm, and Collins, assistants in the Hope Department, Oxford, must not be overlooked, while I have to thank Mr. Horace Knight for his skill in interpreting my rough sketches.

JANUARY 20, 1909.

V. *Birds as a Factor in the Production of Mimetic Resemblances among Butterflies.* By GUY A. K. MARSHALL, F.Z.S.

[Read March 3rd, 1909.]

THE question whether birds do, or do not, prey upon butterflies to any appreciable extent is one which has from time to time engaged the attention of Entomologists for some years past. For it has been contended that the validity of the theories of mimicry enunciated by H. W. Bates and Fritz Müller, as applied to butterflies, must largely depend upon the production of adequate evidence to show that these insects are liable to habitual attacks upon the part of birds. Nor is it possible to deny the reasonableness of such a contention, as soon as we endeavour to reconstruct mentally the processes which must have been at work if those theories be true.

DEFENCES OF BUTTERFLIES.

In their imago state butterflies appear to be among the most defenceless of insects, for their comparatively large size and diurnal habits render them more or less conspicuous objects when on the wing, even though their actual colouring may be dull and obscure. They have, however, three principal lines of defence: (1) rapid or tortuous flight; (2) procryptic under-side coloration, combined with the appropriate instincts for seeking concealment; and (3) the possession of nauseous qualities rendering them distasteful to a large proportion of their enemies.

The existence of these latter qualities has now been experimentally proved beyond the possibility of cavil, and we are probably justified in assuming that they occur in all species of *Danainae*, *Ithomiinae*, *Heliconinae*, and *Acraeinae*. They have also been shown to exist in certain isolated genera of *Nymphalinae*, *Lipteninae*, *Pierinae*, and *Papilioninae*; but there does not appear to be any real justification for the speculative assumption that they are of general occurrence in these and other subfamilies.

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Wherever undoubted distastefulness has been demonstrated by experiment, we find that the species are invariably characterised by a slow, sailing or laboured flight; moreover they do not (except in a very few instances) exhibit any procryptic coloration on the under-surface. Thus the acquisition of unpalatability, which is probably a more specialised form of defence, leads to a partial or complete abandonment of the other two methods. This is only what we should anticipate in accordance with Wallace's law of warning coloration. For distastefulness loses a great part of its protective value unless accompanied by coloration or habits which make for conspicuousness and thus advertise the unpleasant qualities of the insect.

But the diminution of activity in flight can have significance only in relation to winged enemies; that is to say, either birds or predaceous insects. Of the latter the only ones of general occurrence which are known to attack butterflies are Asilid flies, wasps and dragonflies. With regard to Asilidae, Professor Poulton has clearly shown in his admirable paper on predaceous insects (*Trans. Ent. Soc. Lond.*, 1906, p. 363) that these flies are apparently indiscriminate in their attacks on other insects and do not appear to be deterred by any nauseous qualities. There seems to be a certain amount of evidence to show that the same is true of wasps, including Belt's record of the wasp which stocked its nest with *Heliconii*; and probably this applies to dragonflies also, though there is very little evidence at present as to the nature of their food (cf. Poulton, *l.c.* p. 399). But conspicuous colouring and slow movements can be of no utility against enemies which devour with equal avidity both nauseous and normal forms; indeed, rather the reverse. It is therefore difficult to avoid the conclusion that the modification of flight which is so constantly correlated with unpalatability in butterflies must have a particular significance in regard to the attacks of birds.

THE INFLUENCE OF LIZARDS ON MIMICRY.

That certain species of lizards will in a wild state eat butterflies is well established, and it has often been suggested that these reptiles play a considerable part in the production of butterfly mimicry. Yet the evidence

in this direction does not seem to be altogether satisfactory as it stands at present. In South Africa, at all events, the vast majority of lizards live only on the ground or among rocks, and personally I have never met with any truly arboreal species. Yet it is among the tree-frequenting butterflies that warning colours and mimicry find their highest development; nor can I call to mind any undoubtedly mimetic butterfly which normally settles on rocks or on the ground, with the exception of a few species such as *Aterica galene* or *Papilio echerioides*, which only frequent dense forests—localities in which ground lizards are, so far as my own experience goes, conspicuous by their entire absence. Indeed, the habits of the South African Danaines and their many mimics are such as to render it antecedently improbable that they are normally liable to be preyed upon by lizards. It is possible that the conditions are quite different in other tropical countries, but the question does not appear to have been investigated from this point of view, and further observations are to be desired.

OBJECTIONS TO THE VIEW THAT BIRDS ATTACK BUTTERFLIES.

It is now about twelve years ago that this question was discussed at some length at a meeting of this Society (Proc. Ent. Soc., 1897, pp. xiii–xxvi) as the outcome of an interesting paper by Dr. Dixey on the subject of mimetic attraction. Judging by the views advanced during this discussion, as well as those published by other observers, it would appear that a considerable majority of entomologists are of opinion that on the whole butterflies suffer but little from the attacks of birds.

The supporters of these adverse views who are most usually cited in criticisms directed against the theories of mimicry are Scudder (whose experience is confined to N. America), Packard (N. America), Pryer (Japan and Borneo), Piepers (Java) and Skertchley (Borneo). But in regard to Scudder it must be noted that, though he has seen but few cases of birds pursuing butterflies in N. America, yet he readily admits that such occurrences are probably much more frequent in tropical countries (Butterfl. of Eastern U.S., II, p. 1612). Similar negative evidence has more recently been put forward by Sir George Hampson,

from India (Proc. Ent. Soc., 1897, p. xxxviii); Commander J. J. Walker and Col. Yerbury (*l.c.* p. xxxix); J. C. Kershaw, from S. China (Trans. Ent. Soc., 1905, p. 6); Paul Hahnel, from Tropical S. America ("Iris," 1890, pp. 310-321); while Packard has quoted the opinions of a number of his North American correspondents to the same effect, and has generally reviewed the whole subject in a sense adverse to the theory of mimicry in a very able paper entitled "Origin of Markings of Organisms" (Proc. Amer. Phil. Soc., 1904, pp. 393-450), a paper which has been excellently criticised in our Proceedings for 1906 (p. xxxvii) by Eltringham.

The evidence adduced by these authors is necessarily of a purely negative character, being always to the effect that each of them has collected or observed butterflies for a shorter or longer period and yet has not seen any, or at most very few, cases of birds eating butterflies. In dealing with the theories of mimicry most of them are content with a purely destructive criticism, and make no attempt to explain the mass of facts which has now been accumulated by Professor Poulton and his correspondents. Others, such as Hahnel, Skertchley, Eimer, etc., have attempted to suggest alternative theories to explain these striking phenomena. Unfortunately some of the critics have not even taken the trouble to grasp the real nature of the suggestions which they criticise (this is especially true of Fritz Müller's views); and while they unite in condemning the theories of mimicry on the ground that they involve too many assumptions for which there is no experimental evidence, it is noticeable that this criticism applies with even greater force to their own hypotheses, quite apart from the far graver objections which may be raised against all of them. The vague suggestion that mimetic resemblances are all due to the direct action of a similar environment furnishes an excellent example of the ill-digested and wholly inadequate conceptions which pass current among many entomologists who have not made themselves acquainted with the mere rudiments of the subject. But it is not my purpose to discuss these questions here. For in the first place, I am by no means prepared to accept the fundamental assumption which underlies all these alternative interpretations, namely, that at the present time the influence of birds upon butterfly coloration is a negligible quality; and secondly, because

the grave difficulties in the way of accepting any explanation of mimetic resemblances other than Natural Selection have already been very clearly set forth in an admirable paper by Professor Poulton (*Journ. Linn. Soc. Zool.*, xxvi, pp. 558-612), which has been recently reproduced in his book "*Essays on Evolution*," and which it would be well for any would-be critics of the theory of mimicry to "read, mark, learn and inwardly digest" before putting pen to paper.

But to revert to the question of birds, it is clear that the above negative statements have been generally accepted without proper consideration. When a naturalist who has spent some time in the tropics expresses a decided opinion to the effect that birds do not normally eat butterflies, because he has never observed them doing so, it is incumbent upon us, before accepting his evidence as having any real scientific value, to satisfy ourselves that he has made a systematic and thorough investigation of the subject, and that his views are not based merely on casual and inadequate observations. For in a matter of this kind there is grave danger that absence of evidence may be due simply to lack of observation. If a collector maintains that birds do not eat butterflies, we are justified in asking him for a full list of the other insects which he *has* seen captured by birds. And I venture to think that a closer inquiry of this kind would reveal the fact that most of the negative evidence which has been brought up against the Selectionist interpretation of mimicry is really of little worth.

SOME REASONS FOR THE PAUCITY OF EVIDENCE.

There can be no question that the published records of birds attacking butterflies are limited in number, though perhaps more numerous than generally supposed. If then we believe that such attacks are really of comparatively frequent occurrence in certain regions, how are we to account for the fact that so few observations have been recorded? Certain aspects of this question were dealt with by Mr. Trimén in his Presidential Address to this Society in 1897 (*Proc. Ent. Soc.*, p. lxxxix), when he said: "I am persuaded that . . . the dearth of evidence is due to the neglect of well-directed and sustained observation. Little can be gained by merely noting such cases as

happen to force themselves on the collector's attention; the collector must resolutely set himself to search out and keep watch upon what really takes place. Seeing that there is no record of any naturalist's having seriously taken up the investigation of this matter in the field, I think that very much positive evidence could hardly be expected, and that what has been published goes far in the direction of proving that birds must still be reckoned among the principal enemies of butterflies." We must likewise bear in mind that *ex hypothesi* we may expect the attacks of birds to be comparatively infrequent in all those places where mimetic resemblances among butterflies are rare or absent. It is in the region of tropical forests, where both birds and insects are plentiful, that this phenomenon attains its greatest frequency and its highest perfection; but it is precisely in such localities that adequate observations are most lacking. The few entomologists who visit these favoured spots are, not unnaturally, too much preoccupied in the task of mere collecting to be able to devote themselves to long and possibly tedious observations of this kind. And only those who have actually tried it can realise how much time and patience is requisite to obtain even small results, unless the conditions for observation are very exceptionally favourable. Still there can be little doubt that in suitable localities even the busiest collector might add at least a few crumbs to our store of knowledge if he would but keep his eyes open for such occurrences and carefully note the details at the time. In this connection I may quote the remarks of that excellent observer, Dr. Franz Doflein, of the Munich University, who, in his interesting book on his travels in the East, has made some valuable contributions to the present subject ("*Ostasienfahrt*," 1906, pp. 440-446). He there says: "From the observations which I made in the jungles of Ceylon it is quite incomprehensible to me how naturalists who have spent years and tens of years in the tropics can deny this fact [that butterflies are frequently attacked by birds]. I can only suppose that during their wanderings they pay no special attention to such occurrences, so that when on their return they take part in theoretical discussions, they search their memories and their note-books in vain for records of such observations."

As an instance of the manner in which such facts

may be easily overlooked, I may refer to the case of the kestrel in England. I have searched in vain through many books on British Ornithology for any record that this bird eats butterflies; nor is it even mentioned in Naumann's "*Vögel Deutschlands*" (1822), which contains much more information of this kind than most modern works. Yet in the "*Entomologist*" for 1903 (p. 68) there is a most interesting account by Mr. Parkinson Curtis of the behaviour of a kestrel which he observed for some hours on the Ballard Down, near Swanage. The bird was seen to stoop on several occasions at something on the ground, but always rose again without carrying off anything. Most entomologists would have troubled themselves no further about the matter, but, fortunately, Mr. Curtis was prompted to make a closer investigation, and by carefully stalking the bird he found that it was pouncing upon butterflies which it tore to pieces on the ground. In the course of an hour he counted about thirty-six specimens which were captured in this manner, and the bird was observed to continue the pursuit for at least five hours. Nor is this merely an isolated case, for Mr. Curtis has confirmed his observation in every succeeding summer; moreover we have the evidence of Mr. Colthrup that he has seen the kestrel feeding on *Polyommatus corydon* (see p. 352) in 1906 and 1907 on Beachy Head. It is therefore probable that further enquiry will show this to be quite a usual habit of the kestrel which has hitherto been overlooked; and it seems quite conceivable that dozens of entomologists may have collected on Beachy Head and Ballard Down and have remained in ignorance of the destruction of butterfly life which may have been going on in their very presence. Again I can find no record of butterflies being eaten by the Garden Warbler (*Sylvia hortensis*), with the exception of the one published by Professor Kennel (see p. 344), who observed a pair which fed their young almost exclusively on butterflies all day long. It would be unreasonable to suppose that this must be an abnormal case; it seems far more likely that this Warbler does often capture butterflies, but that naturalists have failed to observe the fact, or else failed to record their observations. A final instance may be referred to, namely, the Pigmy Falcons (*Microhierax*) of the East. My lamented friend, the late Col. C. T. Bingham, who lived for many

years in Burma, where these birds are not uncommon, only once observed a butterfly to be seized by one of them. It might be argued that if so admirable and skilled an observer, in the course of a long experience, saw this happen only on a single occasion, the pursuit of butterflies must be an unusual habit with these birds. But fortunately, we have some indirect evidence on this point which aptly illustrates how extremely misleading such an argument may be. These hawks nest in holes in trees, the bottom of the hole being lined with a thick pad composed chiefly of insect remains mixed with rotten wood. Now three different observers have found nests in which this pad consisted largely, or even principally, of butterflies' wings, thus rendering it extremely probable that the Falconets do prey upon these insects to a very considerable extent.

But if records of birds taking butterflies are scarce, it must be borne in mind that the same thing applies to almost all orders of insects. For example, although Coleoptera are very largely eaten by birds, yet it must be admitted that our knowledge of that fact is not really based on direct observation of capture, but is derived from an examination of the contents of birds' stomachs; and it is probable that the number of authentic records of capture would be even less in the case of beetles than in butterflies. If it be urged that the small size of most Coleoptera renders their recognition difficult under such conditions, let us turn to the dragonflies, which afford a very fair parallel to butterflies, so far as size and habits are concerned. Here again my examination of the literature of the subject shows that the observed cases of capture, or even pursuit, are extremely few; and personally, during fifteen years of field experience in South Africa I cannot recollect to have ever seen a bird pursue a dragonfly. But I am by no means prepared to assume from these facts that birds never, or very rarely, attack dragonflies; rather do I believe that this dearth of evidence is simply due, as it certainly is in my case, to the fact that no attention has been paid to this line of inquiry. This belief is borne out by the knowledge that where birds' stomachs have been critically examined the occurrence of dragonflies has been noted in quite a number of cases. An exhaustive examination of the insect remains found in the stomachs of wild birds, must, in most cases, afford the only satisfactory testimony as to what constitutes their normal food; but no such in-

vestigation has ever been undertaken in those tropical regions where mimicry among butterflies is most prevalent, and where we should therefore expect to find the greatest destruction by birds. Moreover, this line of inquiry is unfortunately much less satisfactory in the case of butterflies than in most other insects, owing to the fact that birds so frequently snip off the wings before eating them, thus rendering their recognition almost impossible; and there can be little doubt that the presence of butterflies in birds' stomachs must have been overlooked through this cause. Thus it is rather to ornithologists that we must look for any material addition to our knowledge of this subject; and an attempt to carefully identify the food brought to their young by insectivorous birds would probably yield much valuable information.

Enough has now been said to show that the assumption that birds seldom attack butterflies is certainly premature; and for my part, I am convinced that when the subject has been more fully and systematically investigated that assumption will prove to be entirely unfounded.

We may now turn to the list of available records. So far as concerns those already published, I believe it to be fairly complete, though a certain number must inevitably have escaped my attention. For the remainder I have to offer my hearty thanks to the following friends and correspondents, who have very kindly furnished me with a number of valuable unpublished observations: Mr. Parkinson Curtis, Professor C. B. Davenport, Dr. F. A. Dixey, Dr. F. Doflein, Mr. C. H. B. Grant, Colonel N. Manders, Mr. S. A. Neave, Father O'Neil, Professor E. B. Poulton, Mr. R. Shelford, Mr. C. F. M. Swynnerton and Professor August Weismann.

The number of Observations is unfortunately still too small to justify any broad generalisations from the results shown, but a few salient points may be noted.

The paucity of records in the case of *Lycaenidae* and *Hesperiidae* is probably due to the comparatively small size of these insects, which would thus render them difficult to identify under such conditions. The great majority of the evidence is furnished by the *Nymphalinae* and *Pierinae*, and of these the latter subfamily is always easily first. This is in accordance with Bates' experience on the Amazons. For he says: "I could not, from their excessive scarcity, ascertain on the spot that the *Leptalides*

were thus picked out. I noticed, however, that other genera of their family (Pieridae) were much persecuted" (Trans. Linn. Soc., xxiii, 1862, p. 511). And in the same region Paul Hahnel noted that Pierines were more attacked by birds than any other butterflies ("Iris," 1890, p. 193). These facts render it difficult to accept the view, advocated by Dr. Dixey and Professor Poulton, that the Pierinae probably constitute a generally unpalatable group.

As might have been expected, the number of instances in which birds have been observed to eat butterflies of the dominant distasteful groups, such as Danainae or Acraeinae, is comparatively small. Were these insects as liable to be consumed as the Nymphalinae and Pierinae, it seems likely, owing to their conspicuous appearance and avoidance of concealment, that far more such cases would have been forced upon the attention of casual observers.

Again, it may be noted that many observers have testified to the fact that it is by no means an easy task for a bird to capture a butterfly in full flight, this being true even of such adepts as the Bee-Eaters. My own experience is entirely in accord with this opinion; and we may perhaps find here an explanation why a bird may often be seen sitting apparently impassive and uninterested in the butterflies which are flying in the vicinity; the lack of interest being due to the knowledge that open pursuit is of little avail. It seems likely that attacks will in general be made only under specially favourable conditions, such as, when the butterfly passes very close to the bird's perch, or when the attention of the insect is distracted during feeding, courting, ovipositing, etc. We are, therefore, probably justified in supposing that flight does really afford an important protection to butterflies against the attacks of birds. On the other hand, it has been suggested that flight is probably of minor importance in this connection, and that birds do not commonly pursue butterflies simply because the vast majority of these insects possess distasteful qualities to a greater or less extent. This view I am quite unable to accept, for various reasons which need not be discussed here; nor can it be said to find support in the following records, which indeed furnish strong evidence against it. For several observers, including Prof. Weismann, have testified that butterflies bred in confinement and then released

are specially liable to attack by birds on account of their weak flight (cf. Palaearctic records, 4. *g.*; 10. *d.* and *e.*; 28. *e.*). The point might be decided experimentally by releasing a large number of butterflies whose wings had been partly cut off, then turning loose uninjured specimens of the same species and noting any difference in the attitude of the birds towards them. I have suggested to several of my friends in the tropics that they should undertake such experiments, which might, moreover, prove extremely valuable as a means of ascertaining the likes and dislikes of wild birds under natural conditions.

Finally, it may be interesting to note that the Indian Bee-Eaters appear for the most part to cut off the wings of butterflies which they capture before eating them; whereas the African species, so far as I can ascertain, appear to swallow them whole. It is not easy to understand the reason of this discrepancy in habits in closely allied species.

With reference to the following records it must be noted that where authors have given long lists of insects preyed on by certain birds, for the sake of brevity only those parts which refer to butterflies have been cited. This is especially the case in the Nearctic records from Gentry's "Life Histories of the Birds of E. Pennsylvania," and also in the Palaearctic records from Naumann's "Vögel Deutschlands."

RECORDS FROM THE PALAEARCTIC REGION.

1. *Corvus monedula*, Briss. (Jackdaw). Observed to catch a white butterfly: The Editor, "Country-Side," 1903, p. 290.
2. *Sturnus vulgaris*, L. (Starling). (*a*) "I have often seen them chasing butterflies" (England): R. Fortune, in Watson's "Ornithology in Relation to Agriculture" (1893), p. 139.—(*b*) A starling observed to catch a white butterfly: The Editor, "Country-Side," 1903, p. 290.
3. *Oriolus galbula*, L. (Golden Oriole). "It then [in May] feeds principally on woodland insects, . . . catching cockchafers, butterflies and also large thick-bodied moths, etc.": Naumann, "Vögel Deutschlands," ii, p. 179 (1822).

4. *Passer domesticus*, L. (Sparrow). (a) "I have frequently seen the common sparrow chase and capture such butterflies as *V. urticae* and *P. rapae*": T. G. B. (Cambridge), "Nature," iii, 1870, p. 166.—(b) "I have noticed . . . three sparrows for some time chase and eventually capture a female *Epinephile janira*": R. Trimen, Proc. Ent. Soc. L., 1897, p. xci (England).—(c) "I have certainly observed sparrows catching butterflies": W. Caspari, Soc. Ent. Zurich, xvi, 1901, p. 34 (Switzerland).—(d) A sparrow observed "chasing a specimen of *Vanessa urticae*, at Whitstable, which it captured": C. W. Colthrup, "Entomologist," 1903, p. 173.—(e) "I can remember having once witnessed a sparrow chase and catch a fine specimen of *Argynnis adippe*": C. Floersheim, "Ent. Record," 1906, p. 36.—(f) "In my garden at Munich a *Vanessa c.-album* was pursued and captured by a sparrow, on the 3rd July, 1906": Dr. Franz Doffein (*in litt.*).—(g) "In the experiments in rearing Vanessidae in Battersea Park [London] a few summers ago . . . the sparrows at once found out the difference between those reared under glass and the wild ones, and soon exterminated them": E. T. Daubeny, "Nature Notes," Oct., 1905, p. 197.—(h) "June 7, 1906. Kensington Gardens [London]. In the wide grassy space east of the palace, passing down to the Serpentine, I saw a large *Vanessa* (looking like *V. polychloros*) flying in the sunshine. It was pursued by a sparrow, which made two ineffectual attempts to catch it and then desisted. The chase was immediately taken up by another sparrow, and pursuer and pursued disappeared from view among the trees": Dr. F. A. Dixey (*in litt.*).—(i) At Fawley, near Southampton, on the 13th June, 1907, I myself saw a sparrow catch and eat a *Pieris rapae*.—(j) "The sparrow, I have frequently observed, attacks *Pieris brassicae* and *P. rapae* on the wing, but is not very successful as a rule. I can only remember two instances of capture. I have also seen it on three occasions attack *Macroglossa stellatarum*, but in every case unsuccessfully": W. Parkinson Curtis (in a letter to Prof. Poulton, dated 22, ix, 1905).—(k) "Colonel Coussmaker remarked to me that he had seen sparrows taking butterflies, including the common 'whites,' far more frequently than any

- other birds; probably, I imagine, because commoner than any other birds": C. F. M. Swynnerton (letter dated 1, viii, 1907).—(l) "For the first time in my life I saw this summer a sparrow pursue and catch a Large Tortoiseshell that was flying round an elm tree": O. H. Latter (in a letter to Prof. Poulton, dated 31, xii, 1902).—(m) A sparrow observed to eat a *Pieris rapae*, of which it cut off the wings: L. H. Harris, "Country-Side," 1907, p. 140.—(n) "Small Tortoiseshell chased by a sparrow, which only succeeded in taking a piece out of one wing": J. R. Harding, "Country-Side," 1907, p. 209 (England).—(o) "Last year I bred a large number of the large white butterfly, which emerged from the pupae this year. On letting some of the butterflies go, two of them were immediately seized by house sparrows, which only ate the body and left the four wings behind. On two other days the same thing happened. In all, four were killed in this way, and they were all males": G. Blackburn, "Country-Side," 1907, p. 211 (England).—(p) "Sparrow seen to take a peacock butterfly in full flight": J. J. Towns, "Country-Side," 1907, p. 307 (England).—(q) "From interesting and numerous letters in answer to the question whether birds eat butterflies, I find that thirty-eight correspondents have seen the sparrow catch and in most cases devour common white butterflies. . . . Five correspondents have seen the sparrow eat the brimstone; two have seen it catch, or partly eat, the meadow-brown; two the small blue; one a large fritillary; and one a tortoiseshell": The Editor, "Country-Side," 1903, p. 290 (England).—(r) Prof. E. Pénard of Geneva saw a bird, probably a sparrow, persistently pursue and at the third attempt capture a white butterfly (probably a species of *Pieris*): Prof. E. B. Poulton, "Essays on Evolution," p. 282, note.
5. *Acanthis cannabina*, L. (Linnet). To my astonishment a linnet (Hänfling), which was singing on a tree-top, suddenly became silent and swooping down adroitly captured an *antiopa*: B. Slevogt, Soc. Ent. Zurich, xvii, 1901, p. 82 (Switzerland).
 6. *Parus sp.* (Tit). (a) "Captures with astonishing accuracy the butterflies which flit about the trees": W. Caspari, "Soc. Ent. Zurich," 1901, p. 34.—(b) A

- tit observed to eat a white butterfly: The Editor, "Country-Side," 1903, p. 290 (England).
7. *Parus major*, L. (Great Tit). "I have seen a great titmouse capture the White Butterfly (*Pieris rapae*) on the wing": W. Eagle Clarke, quoted by Prof. Poulton, "Nature," lxxv, p. 465 (England).
 8. *Motacilla* sp. (Wagtail). (a) A good account of the pursuit and final capture of a Small Tortoiseshell (*Vanessa urticae*, L.) by this bird. The observer infers from the method used by the bird "that it was not a mere attack brought on by curiosity, but the result of experience, which had taught it that the body and not the wings was the desired tit-bit": H. J. Turner, "Ent. Record," 1904, p. 335 (England).—(b) A wagtail observed to catch a white butterfly: The Editor, "Country-Side," 1903, p. 290 (England).
 9. *Pratincola rubetra*, L. (Whinchat). "On another evening, August 16th, 1907, at Beachy Head, I watched a pair of furze-chats picking specimens of [*Polyommatus*] *corydon* off grass stems and taking them to a small tree. On going to the tree to investigate, the two birds flew off together with a brood of young ones. Under the tree on the ground were about thirty or forty wings of male *corydon*": C. W. Colthrup, "The Country-Side," March 21, 1908, p. 267.
 10. *Phoenicurus phoenicurus*, L. (Redstart). (a) "They take flies, gnats, small butterflies and all sorts of small two- and four-winged insects, partly on the wing and partly at rest": Naumann, "Vög. Deut.," ii, p. 519.—(b) "It feeds on flies, gnats, small butterflies and various other kinds of small coleopterous and other insects, caterpillars, etc.": H. Dresser, "Birds of Europe," ii, p. 281.—(c) "I have also repeatedly observed in my own country [Switzerland] how the Redstart (Rotschwänchen), which seems to have a special liking for butterflies, would catch 'Whites' on the wing and take them to the nest": Prof. L. Kathariner, "Biol. Centralb.," 6. xviii, 1898, p. 681.—(d) The author states that every year he was in the habit of releasing hundreds of butterflies (especially *Vanessae*) bred in temperature experiments, and that the birds of the neighbourhood would then congregate and pursue the insects, whose flight was still weak. He notes that a pair of red-

starts were especially active in their attacks. On the other hand *Arctia caja* was never touched: C. Frings, "Soc. Ent. Zurich," 1900, p. 76 (Switzerland).—(c) "About fifteen years ago I bred numbers of *Vanessa io* and *urticae* every summer; I released many of the thousand specimens of butterflies that I obtained. Every summer I began by letting the insects fly out of the window of my work-room. But very soon this was noticed by the birds in the garden which surrounds the Institute, and then a redstart used generally to station itself on a neighbouring bush or tree and carry off most of the butterflies which were released. I often saw the bird fly quite close to the open window, seize a butterfly, turn quickly round and fly away again. Then it would tear off the wings and one would find afterwards many wings of *V. io* and *urticae* lying on the ground. . . . In dull weather most of the butterflies did not fly away, but remained sitting on the window-ledge. Then the bird (*Ruticilla phoenicea* or *tithys*) would come right up to the ledge. . . . My assistant Dr. Schleiss once released, instead of myself, a number of *urticae* from the window. The redstart appeared immediately, and in a short time he saw lying on the garden path about thirty wings of *Van. urticae*" (Freiburg in Breisgau): Prof. August Weismann (in a letter to Prof. E. B. Poulton, dated 14, ii, 1909).

11. *Accentor modularis*, L. (Hedge Sparrow). "On the May 15 [1907] I saw a hedge sparrow capture a freshly emerged *Pieris rapae* ♂ and devour it. The specimen was insufficiently dried to be strong on the wing, and was captured whilst indulging in a first unsteady flight. The occurrence took place at Broadstone, Dorset": W. Parkinson Curtis (letter to Prof. Poulton, dated 29, v, '07).
12. *Erithacus rubecula*, L. (Robin). (a) "I can certify to the fact of robins chasing and catching large white butterflies on the wing and swallowing them whole": H. Fox, "Nature," lxi, 1899, p. 152 (England).—(b) "I saw a male robin once strike at *Pyrameis atalanta*, but, on the butterfly turning, he made no further attempt": C. Floersheim, "Ent. Record," 1906, p. 36.—(c) "I had [September 1900] a number of *Colias edusa* ♀ sleeved in a small hand-frame with clover to

induce them to lay eggs, but they came to an untimely end. I saw a robin industriously pecking at the muslin covering the frame, and shortly after being disturbed he returned, started again where he had weakened the muslin, and forcing his way in, slew and ate all the *Colias edusa*. The *edusa* were visible through the muslin and were walking about on the clover. . . . The same robins this spring destroyed some female *cardamines* under similar circumstances": W. Parkinson Curtis (in a letter to Prof. Poulton, dated 22, ix. 1905).—(d) The robin has been seen to chase, catch or eat common white butterflies by five correspondents; while two have seen it take blue butterflies: The Editor, "Country-Side," 1903, p. 290 (England).

13. *Turdus viscivorus*, L. (Missel Thrush). Observed to catch a white butterfly: The Editor, "Country-Side," 1903, p. 290.
14. *Aerocephalus palustris*, Bechst. (Marsh Reed Warbler). "They seek many kinds of insects, such as . . . small dragon flies, Phryganidae, Tineidae and small butterflies": Naumann, "Vög. Deut." iii, p. 640.
15. *Aerocephalus schacrobarnus*, L. (Sedge Warbler). A pair of Sedge Warblers was observed of which "each had a butterfly in its mouth, and with my field-glasses I was able to identify the species as a Meadow-Brown (*E. janira*) and a Small White (*P. rapae*)": O. H. Latter, "Nature," ix, 1899, p. 520 (England).
16. *Sylvia hortensis*, Bechst. (Garden Warbler). In 1895 at Dorpat, in Russia, Prof. Kennel observed a pair of Garden Warblers (Grasmücken) "which fed their five young all day long almost exclusively with *Vanessa urticae*, and occasionally with a few *Parnassius amosyne* [*mnemosyne*] and *apollo*, the latter being a very scarce species in the neighbourhood." He subsequently adds that *Pieris rapae* was also used as food by these birds: Prof. J. Kennel, "Biol. Centralb.," xviii, 1898, p. 810.
17. *Sylvia curruca*, L. (Lesser White-throat). "But they also eat various insect-eggs, small pupae, many small two- and four-winged insects, different species of green plant-lice (*Aphis*, Linn.), small butterflies and so forth": Naumann, "Vög. Deut." ii, p. 457.
18. *Phylloscopus trochilus*, L. (Willow Wren). Observed

- to catch a white butterfly: The Editor, "Country-Side," 1903, p. 290.
19. *Regulus regulus*, L. (Golden-crested Wren). The Goldcrest (Goldhänchen) also captures butterflies which flit about the trees: W. Caspari, "Soc. Ent. Zur.," xvi, p. 34.
 20. *Troglodytes troglodytes*, L. (Wren). This bird was observed to persistently enter a house and carry off a considerable number of hibernating *Vanessa urticae*: A. Elliott, "Ann. Scot. Nat. Hist." 1900, p. 53 (Scotland).
 21. *Lanius minor*, Gm. (Lesser Grey Shrike). (a) Its food "consists of butterflies, various beetles, grasshoppers and other insects": Naumann, "Vög. Deut." ii, p. 20.—(b) A *Papilio podalirius*, L. was found in the stomach of one *Lanius minor*: E. Csiki, "Aquila," xi, 1904, p. 278.
 22. *Lanius auriculatus*, Müll. (Woodchat Shrike). "It feeds on beetles, grasshoppers, butterflies, dragonflies, and various other insects which it catches on the wing": Naumann, "Vög. Deut.," ii, p. 27.
 23. *Lanius collurio*, L. (Red-backed Shrike). (a) "It also catches with dexterity flying beetles, butterflies, grasshoppers, and so forth": Naumann, *l. c.* p. 35.—(b) "On July 2, 1896, on Patcham Railway Embankment, near Brighton, I found a *Pieris rapae* ♂ impaled on a sharp sedge by a red-backed shrike. It was pinned neatly through the centre of the thorax and was running round on the pivot thus formed when I investigated it": W. Parkinson Curtis (letter to Prof. Poulton, dated 22, ix, 1905).
 24. *Muscicapa grisola*, L. (Spotted Flycatcher). (a) "It feeds on flies, especially of the Linnean genera *Musca* and *Conops*, on gadflies, gnats, crane-flies, butterflies, small grasshoppers, small dragonflies and various other insects": Naumann, *l. c.* ii, p. 220.—(b) "I have seen the common flycatcher take butterflies more than once. I can well remember how gracefully one swept from the bough of a chestnut and caught a *Lasiommata aegeria* in its flight": R. C. R. Jordan, "Ent. Mo. Mag.," xxiv, 1887, p. 86.—(c) "I have seen the common spotted flycatcher pursue a butterfly and miss it, giving up the pursuit (H. S. Wise)": Lilian Vesey, "Nature," lxx, 1902, p. 392.—(d) "I was chasing a Clouded Yellow (*Colias edusa*, F.) . . . when, much

to my chagrin, a Spotted Flycatcher (*Muscicapa grisola*) darted from a fence and caught it": A. H. Hamm, "Nature," lxxv, 1902, p. 366 (England).—(e) "On July 21st [1904] we saw at Evian-les-Bains (France) a spotted flycatcher catch a brown butterfly, almost certainly *Epinephele jurtina*": Alfred Sich, "Entom. Rec.," 1904, p. 268.—(f) "After a storm a grey flycatcher darted at a flying white butterfly (Cabbage White?). At the second attack it seemed to have damaged the butterfly's wings, for the latter, in spite of all its fluttering, came nearer to the ground. It was only at the third attempt that the bird succeeded in catching the butterfly, which it immediately swallowed whole": A. Hölscher, "Ill. Zeits. Ent.," 1899, p. 91 (Osnabrück).—(g) "Aug. 23, 1903, Fellows' Garden, Wadham College [Oxford]. Saw a flycatcher seize and fly off with a white butterfly on the wing. After being carried for a little distance the butterfly escaped and was chased by the flycatcher, which made four or five ineffectual attempts at recapture, at each of which I distinctly heard the snap of the bird's beak. The chase disappeared behind trees, and I did not see the result; my impression is that the butterfly escaped": Dr. F. A. Dixey (*in litt.*).—(h) "Aug. 28, 1903. Grounds of Alexandra Palace, Muswell Hill, near London. Saw a flycatcher settled with what appeared to be a white butterfly in its beak. In a short while I saw the wings detached and fall to the ground, but on searching afterwards I failed to find them. The grass was long and there was a good deal of undergrowth": Dr. F. A. Dixey (*in litt.*).—(i) "A small tortoiseshell butterfly, which had been weakened by fluttering in a window, on being liberated was at once pounced upon and eaten by a flycatcher": E. T. Daubeny, "Nature Notes," October 1905, p. 197.—(j) "This summer (1905) a pair of Flycatchers (*Muscicapa grisola*) nested in a garden belonging to a friend of mine. I saw this bird catch, kill and eat *Pieris rapae* ♂. One specimen only was attacked, and this happened to pass close to the bird's favourite seat": W. Parkinson Curtis (letter to Prof. Poulton, 22, ix, '05).—(k) "On July 30 [1907], as I was walking with Col. Coussmaker [in Surrey], I saw a flycatcher (*M. grisola*) swoop low over the grass and return to its

perch with a 'meadow-brown' in its bill. The butterfly was held by the wings only, body outwards, and the bird had hardly reached the perch when the insect escaped and disappeared behind some foliage, with the flycatcher again in hot pursuit": C. F. M. Swynnerton (in a letter dated 1, viii, 1907).—(l) "Mrs. Blackburn [of Barrow Hill, Henfield] made the remark that their 'meadow-browns' (*janira*) were so caught and eaten by the flycatchers as to be quite scarce; when one of them appeared it was generally snapped up, and sometimes two flycatchers would help each other in the capture. The common white butterflies (*rapae*, etc.), were sometimes, but rarely, attacked": F. Merrifield (in a letter to Prof. Poulton, dated 7, viii, 1907).—(m) "I was walking round the paddock [New Barnet, Herts.] yesterday when a large cabbage butterfly came flying across it. There were three Flycatchers (*M. grisola*) in sight. The butterfly passed the first without being attacked, but settled in the grass just in front of the second and about ten yards from it. The bird, which had been watching it, continued to do so for two or three seconds longer and then flew down at it, but failed to secure the butterfly, and rising, turned and again swooped down on the spot. This time it hovered for a few seconds while hunting for the butterfly, but the latter had evidently got well down under the grass, and the flycatcher returned to its perch discomfited": C. F. M. Swynnerton (letter dated 16, viii, 1907).—(n) "Mrs. Watt-Smyth told me that two or three weeks ago, when she was walking in the garden here [New Barnet] with my sister and cousin, they saw a flycatcher capture a white butterfly": C. F. M. Swynnerton (letter dated 19, viii, '07).—(o) "Spotted flycatchers seen on August 1st near Canterbury catching and eating meadow-brown butterfly": F. C. Snell, "Country-Side," 1907, p. 290.—(p) "On an Arabian burial ground, below Las Glacières Blida [in Algeria], I saw at noon a small brown bird (doubtless the grey flycatcher, which is plentiful there) catch a specimen of *Pieris rapae* on the wing": Dr. Karl Jordan (in a letter to Prof. Poulton, dated 21, ix, 1908).—(q) "A water wagtail [Dr. Longstaff informs me that this is an error, and that the bird was a grey

flycatcher] has this year built a nest in the *Ampelopsis veitchii* on my house at Putney. Miss C. A. Dixon was sitting in the garden on July 19 watching the bird go every few minutes to feed its young, and on one occasion noticed that it carried a white butterfly in its beak. On July 25 the same lady saw the bird snap at a white butterfly but miss it": Dr. G. B. Longstaff, "Ent. Mo. Mag.," 1904, p. 211.—(r) "On one other occasion the owner of that lawn saw a bird try to catch a butterfly. He was astonished to see more than one bird chasing what he took to be a small meadow-brown. At last a flycatcher knocked the insect to the ground almost at my friend's feet. He picked it up and found a white-letter hairstreak (*T. w-album*), a butterfly which he did not know was to be found in the neighbourhood": H. P. R., "Country Life," March 14, 1908, p. 384 (England).—(s) The flycatcher has been seen to chase, catch or eat common white butterflies by five correspondents: The Editor, "Country-Side," 1903, p. 290 (England).

25. *Muscicapa collaris*, Bechst. (White-collared Flycatcher). "It feeds on flies, gnats . . . butterflies and other insects on the wing": Naumann, "Vög. Deut.," ii, p. 329 (1822).
26. *Muscicapa atricapilla*, L. (Pied Flycatcher). "It also eats small grasshoppers, butterflies, etc., in times of scarcity, even worms": Naumann, *l. c.* p. 237.
27. *Muscicapa parva*, Bechst. (Red-breasted Flycatcher). "It feeds, like the other flycatchers, on flies, gnats, small butterflies and so forth": Naumann, *l. c.* p. 274.
28. *Hirundo rustica*, L. (Swallow). (a) "They subsist on a great number of genera and species of small insects, as flies, *Stomoxys* (Stechfliegen) . . . small Lepidoptera, as: Tineidae, Pyralidae, Tortricidae, Alucitidae, numerous small beetles and so forth; and in times of need they will also eat small butterflies (the larger ones are not eaten, as their wings are mostly too broad), small Noctuidae, and the smallest dragonflies": Naumann, *l. c.* vi, p. 61.—(b) "In the month of March during the northern migration of swallows, a small butterfly, *Thestor ballus* (one of the Lycaenidae), is out in great abundance on the plains. When walking across the grass, the swallows, which keep flying very close to the leeward of you, instantly

catch any unfortunate *ballus* that flies up; but they seem to be unable to take them on the ground, perhaps from the protective colouring of their green under-wings they cannot see them when at rest; but anyway the swallow is an annoyance to the butterfly collector": Lt.-Col. Irby, "Ornith. of the Straits of Gibraltar," p. 94 (1895, 2nd ed.).—(c) "In England I have noticed a swallow hunting one of the common 'Whites' (apparently *Pieris brassicae*): R. Trimen, Proc. Ent. Soc. L., 1897, p. xci.—(d) "I have several times had opportunities of observing that white butterflies were captured on the wing by swallows": M. Spaeth, "Ill. Zeits. Ent.," 1899, p. 124 (Germany).—(e) "A good many years ago I released a large number of 'Camberwell Beauties' (Trauermäntel). The Swallows collected in a row in front of the window in order to snap up the butterflies. I do not believe that 20 per cent. of the latter reached the adjoining wood, towards which they all directed their course. The same thing happened in the case of some 'Purple Emperors' (Schillerfalter) a few years later. 'Tortoiseshells' (Füchse) and 'Peacocks' (Tagpfau) were entirely unmolested by swallows . . . *Melitaea* and *Argynnis* were taken": W. Caspari, Soc. Ent. Zurich, xvi, p. 34.—(f) Observed to capture *Lycaena argiolus* on the wing: Prof. E. B. Poulton, "Nature," lxxv, 1902, p. 343.—(g) "Mr. W. Holland tells me that about the middle of June 1901 he saw a swallow swoop down from a great distance and catch a white butterfly (almost certainly *Pieris rapae*) flying in front of the [Oxford] Museum": Prof. Poulton, *l.c.*—(h) "Further, I have often seen birds catch butterflies in Hongkong, Cochin China and Europe, but neither birds nor butterflies were identified. The birds were in many cases swallows": Dr. F. Doflein (in a letter dated 12, iv, 1907).—(i) "Mortehoe, N. Devon. W. Bonner saw a swallow 'spike and carry off' a brown butterfly (he thinks *H. janira*). Aug. 23, 1894. Reported to me the same day": Dr. F. A. Dixey (*in litt.*).—(j) "On the afternoon of July 7, 1901, H. G. Dixey kicked up a specimen of *H. janira* in the Parks, Oxford. As it rose it was taken by a swallow. This was seen by J. Dixey, H. G. Dixey and R. N. Dixey, and reported

to me the same day": Dr. F. A. Dixey (*in litt.*).—*(k)* "I have seen butterflies attacked by the Barn Swallow (*H. rustica*) and the Swift—*P. rapae* in both cases": W. Parkinson Curtis (letter to Prof. Poulton, 22, ix, '05).—*(l)* A swallow was observed to capture a *Colias edusa*: W. Buckler, "Ent. Mo. Mag.," July 1877, p. 40.—*(m)* "Some years ago I saw a swallow trying to seize a red admiral flying": G. E. Johnson, "Country-Side," 1907, p. 141 (England).—*(n)* The swallow has been observed to chase, catch or eat common white butterflies by four correspondents; "two readers have seen the swallow take meadow-browns (Mr. J. Higgs, of Maryborough, noting seven specimens taken in seven minutes), and one each have noticed the capture of a peacock butterfly, a painted lady and a tortoiseshell": The Editor, "Country-Side," 1903, p. 290 (England).

29. *Cypselus apus*, L. (Swift). *(a)* "All sorts of beetles, gadflies, butterflies and moths, . . . serve to fill its rapidly digesting, and therefore always hungry, stomach": Naumann, "Vög. Deut.," vi, p. 130.—*(b)* Cf. *Hirundo rustica* *(k)*.
30. *Caprimulgus europaeus*, L. (Nightjar). "And further the flower-beetles, dragonflies, butterflies and Diptera, which sit at rest in the evenings, do not escape it": Naumann, *l.c.* vi, p. 153.
31. *Merops apiaster*, L. (Bee-Eater). Prof. Kathariner records that on May 6, 1895, at Angora in Asia Minor, the butterfly *Thais cerisyi* was flying in great numbers, when suddenly a swarm of Bee-Eaters appeared, and "without paying any attention to me, began to make a terrible clearance among the butterflies. One heard continuously the snapping of their beaks, and in the shortest space of time there was not a butterfly to be seen. Those that were not eaten had hidden under the herbage": L. Kathariner, "Biol. Centralb.," xviii, 1898, p. 681.
32. *Cuculus canorus*, L. (Cuckoo). *(a)* An example of *Aporia crataegi* found in the stomach of one bird: E. Csiki, "Aquila," xi, 1904, p. 309.—*(b)* "Although its principal food consists of caterpillars, yet it often takes both butterflies and moths, and even lepidopterous pupae and eggs are not despised": J. A. Link, "Mon. Deut. Ver. Schutze Vög.," 1889, p. 439.

33. *Falco tinnunculus*, L. (Kestrel). (a) This bird was seen (near Swanage, Dorset) to capture numerous butterflies (*Argynnis aglaia* and *Melanargia galatea*) by pouncing on them when settled on the ground. The observer "found by counting that the bird caught about thirty-six specimens in an hour, and it was hard at it for at least five hours": W. Parkinson Curtis, "Entomol.," 1903, p. 68.—(b) "I would say that my note on the Kestrel in the 'Entomologist' in 1903 has been confirmed by repeated observations at the same place, and presumably on the same pair of birds every year since. In July 1904 I was a month at Swanage and was at least a dozen times on the Down in daylight, when the Kestrel was at its old game of slaughtering *Argynnis aglaia* and *M. galatea*. Last season (July 1905) *aglaia* was scarce and the attacks were confined almost wholly to *semele* and *galatea*; at least, the wings I saw mostly belonged to those species": W. Parkinson Curtis (letter to Prof. Poulton, 22, iv, '05).—(c) I have recently received several further communications from Mr. Parkinson Curtis with regard to his extremely interesting and valuable observations on the feeding habits of the Kestrel. On Aug. 8, 1907, he wrote: "On August 3 I had to go near the Ballard Down, so walked to the place where I had generally seen the Kestrel; it was doing precisely the same thing as I have previously recorded and at about the same average rate." On Sept. 2 he wrote: "On Sept. 1st I was collecting on Studland Hill and Nine Barrow Down, that is about $2\frac{1}{2}$ miles from the Kestrels I have sent you a note about. I saw three Kestrels catching butterflies; they were at it, off and on, from 11.30 a.m. to 3.45 p.m., but I could not get near enough to see what they were catching. That they were catching butterflies, all three, I am certain from the manner of hawking, and their movements on the ground; but there was no cover for me to approach them, so I cannot give you any precise details, except one female *semele* which I put up and which flew in the direction of one Kestrel and was promptly captured." In reply to inquiries, Mr. Curtis informed me that Pierines of all kinds were very scarce on the Downs frequented by the Kestrel, and he had not actually seen any

attacked. *Lycaenidae*, *Hesperiidae* and *Coenonympha* he considered to be too small for the Kestrels, and he had only on one occasion observed the capture of a female *Hesperia actaeon*.—(d) "At Beachy Head in the past summer and in 1906 I watched a Kestrel feeding on this species [*Polyommatus corydon*]. It hovered just over the grass stems and picked them off one after the other while at rest": C. W. Colthrup, "Country-Side," 1908, p. 267.

34. *Falco subbuteo*, L. (Hobby). The stomach of a specimen contained "the body of a small Locustid, a middle-sized butterfly and about 120 brownish-black ants (*Formica fusca*, L.)": Prof. Salzmann, "Mon. Deutsch Ver. Schutz Vög.," 1906, p. 511.

35. Birds not identified:—

(a) A bird captured and ate a specimen of *Argynnis adippe*: Colthrup, "Entom." 1903, p. 173 (England).—(b) "During many years of entomological work I have on only ten occasions actually observed birds pursuing species of *Vanessa* or *Pieris* under natural conditions": C. Frings, "Soc. Ent. Zurich," xv, 1900, p. 76.—(c) "I have frequently seen birds catch and devour the unprotected species [of butterflies] on the wing": A. G. Butler, "Nature," iii, 1870, p. 166 (England).—(d) "In this country it was not an uncommon sight to see the *Pontiae* pursued by birds, and sometimes escaping by means of their tortuous or dodging flight": H. W. Bates, Proc. Ent. Soc. L., 1864 (3), ii, p. 22 (England).—(e) "Evidence of the attacks of birds was supplied by Mr. Fred Birch in a specimen of *Thecla quercus* from Lancashire (August 1898). A bird was seen to dart at the spot where the butterfly was settled, and the insect, when captured, exhibited symmetrical injuries, such as would be caused by a snip taken out of both wings when in contact in the position of rest": Prof. E. B. Poulton, "Oxford Univ. Gazette," 1905, p. 566.—(f) "No one has been able to adduce any examples of a bird eating a butterfly, beyond a few cases where the food was either the 'meadow-brown or large heath (*E. janira* or *E. tithonus*), or the green hairstreak'—out of thousands of observers, entomologists and ornithologists": H. P. R., "Country Life," March 14, 1908, p. 384. [The evidence here collected sufficiently demonstrates

the inaccuracy of this dogmatic statement.—G. A. K. M.]—(g) “My assistant Dr. Kuhn saw a small bird (?) seize a *Vanessa C-album* on the wing” (Freiburg im Breisgau): Prof. Aug. Weismann (letter to Prof. Poulton, dated 14, ii, 1909).

The following list gives a summary of those butterflies which have been exactly or approximately identified, together with the birds which have pursued or eaten them—

PALAEARCTIC BUTTERFLIES.

SATYRINAE.

- Melanargia galatca*, L.—Falco tinnunculus (33, a, b).
Epinephele janira, L.—Passer domesticus (4, b, q); Acrocephalus schaenobaenus (15); Muscicapa grisola (24, k, l, o); Hirundo rustica (28, i, j, n).
E. tithonus, L.—Bird (35, f).
E. jurtina, L.—Muscicapa grisola (24, e).
Hipparchia semele, L.—Falco tinnunculus (33, b, c).
Pararge egeria, L.—Musc. grisola (24, b).

NYMPHALINAE.

- Argynnis* sp.—Passer domesticus (4, q).
A. adippe, L.—Passer domesticus (4, e); Bird (35, a).
A. aglaia, L.—Falco tinnunculus (33, a, b).
Melitaea sp.—Hirundo rustica (28, e).
Pyrameis atalanta, L.—Erithacus rubecula (12, b); Hirundo rustica (28, n).
P. cardui, L.—Hirundo rustica (28, n).
Vanessa io, L.—Passer domesticus (4, p); Phoenicurus phoenicurus (10, e); Hirundo rustica (28, n).
V. antiopa, L.—Acanthis cannabina (5); Hirundo rustica (28, e).
V. polychloros, L.—Passer domesticus (4, h, l).
V. urticae, L.—Passer domesticus (4, a, d, n, q); Motacilla, sp. (8, a); Phoenicurus phoenicurus (10, e); Sylvia hortensis (16); Troglodytes troglodytes (20); Muscicapa grisola (24, i); Hirundo rustica (28, n).
Polygonia C-album, L.—Passer domesticus (4, f); Bird (35, g).
Vanessidi.—Pass. domesticus (4, g); Phoenicurus phoenicurus (10, d); Bird (25, b).
Apatura iris, L.—Hirundo rustica (28, e).

LYCAENINAE.

- Polyommatus icarus*, Rott.—*Passer domesticus* (4, *q*).
P. corydon, Poda.—*Falco tinnunculus* (33, *d*); *Pratincola rubetra* (9).
Cyaniris argiolus, L.—*Hirundo rustica* (28, *f*).
Thestor ballus, F.—*H. rustica* (28, *b*).
Callophrys rubi, L.—Bird (35, *f*).
Thecla quercus, L.—Bird (35, *c*).
T. w-album, Knoch.—*Muscicapa grisola* (24, *r*).
Lycaeninae.—*Erithacus rubecula* (12, *d*).

PIERINAE.

- Aporia crataegi*, L.—*Cuculus canorus* (32, *a*).
Pieris spp.—*Corvus monedula* (1); *Sturnus vulgaris* (2, *b*); *Passer domesticus* (4, *k, q, r*); *Parus* sp. (6, *b*); *Motacilla* sp. (8, *b*); *Phoenicurus phoenicurus* (10, *c*); *Erithacus rubecula* (12, *d*); *Turdus viscivorus* (13); *Phylloscopus trochilus* (18); *Muscicapa grisola* (24, *f, g, h, n, q, s*); *Hirundo rustica* (28, *d, n*); Bird (35, *b, d*).
P. rapae, L.—*Passer domesticus* (4, *a, i, j, m*); *Parus major* (7); *Accentor modularis* (11); *Acrocephalus schaenobaenus* (15); *Sylvia hortensis* (16); *Lanius collurio* (23, *b*); *Muscicapa grisola* (24, *j, l, p*); *Hirundo rustica* (28, *g, k*); *Cypselus apus* (28, *k*).
P. brassicae, L.—*Passer domesticus* (4, *j, o*); *Erithacus rubecula* (12, *a*); *Muscicapa grisola* (24, *m*); *Hirundo rustica* (28, *c*).
Euchloë cardamines, L.—*Erithacus rubecula* (12, *c*).
Colias edusa, F.—*Erithacus rubecula* (12, *c*); *Muscicapa grisola* (24, *d*); *Hirundo rustica* (28, *l*).
Gonepteryx rhamni, L.—*Passer domesticus* (4, *q*).

PAPILIONINAE.

- Thais cerisyi*, Godt.—*Merops apiaster* (31).
Parnassius apollo, L.—*Sylvia hortensis* (16).
P. mnemosyne, L.—*Sylvia hortensis* (16).
Papilio podalirius, L.—*Lanius minor* (21, *b*).

RECORDS FROM THE ETHIOPIAN REGION.

1. *Motacilla capensis*, L. (Cape Wagtail). (*a*) "I not only obtained an Arctiid moth (*Binna madagascariensis*), which I surprised one of these birds in the act of kill-

- ing, but also saw another actually pursuing a butterfly belonging to the genus *Acraea*": W. L. Distant, "Naturalist in the Transvaal," p. 70.—(b) Seen to "take moths and *P. [Pieris] hellica*": J. P. Mansel Weale, "Nature," iii, p. 508 (Cape Colony).
2. *Motacilla* sp. (Wagtail). Prof. Yngve Sjöstedt, of Stockholm, informs me that although he paid no special attention to this subject, he well remembers to have observed birds of this genus pursuing and capturing butterflies in the beds of rivers on the Cameroon Mountain in West Africa.
 3. *Nectarinia* sp. (Sunbird). "Mrs. Barber informs me that *Pyrameis cardui* is a frequent victim among the butterflies with which the Sunbirds (*Nectariniæ*) feed their young": R. Trimen, "S. Afr. Butterf.," i, p. 34, note (Cape Colony).
 4. *Apalis thoracica*, Shaw (Bar-throated Warbler). On June 7, 1903, near Salisbury, Rhodesia, I myself saw one of those birds catch an *Acraea nohara-halali*, Mshl., which it ate with apparent relish.
 5. *Pratincola torquata*, L. (South African Stonechat). "In March [1900] I saw a *Pratincola torquata* in chase of *Tarucus plinius*": C. F. M. Swynnerton, Trans. Ent. Soc. Lond., 1902, p. 358 (Gazaland).
 6. *Lanius collaris*, L. (Fiscal Shrike). "At the Cape I have seen *Fiscus collaris*, the common shrike of the colony, seize in succession several *Papilio lycaeus* on the wing": R. Trimen, Proc. Ent. Soc., 1897, p. xci.
 7. *Bradyornis maricensis*, Sm. (Marico Wood-Shrike). "Feb. 27, 1898. Saw a Marico wood-shrike dart down from a tree and catch a *Sarangesa eliminata*, Holl., which was sitting with outspread wings on a small plant": G. A. K. Marshall, Tr. Ent. Soc. 1902, p. 357 (Rhodesia).
 8. *Pachyrhiza molitor*, Hahn and K. (White-flanked Flycatcher). (a) "March 6, 1898. Saw a flycatcher (*Pachyrhiza molitor*) make several futile attempts to catch a *Tarucus plinius*, which was circling round the bush on which it sat." G. A. K. Marshall, l. c. p. 357 (Rhodesia).—(b) On June 7, 1903, near Salisbury, Rhodesia, I saw one of these birds eat a small Lycaenid (probably *Tarucus telicanus*) and a small Hesperid (probably *Baoris detecta*).
 9. *Trochocercus albonotatus*, Sharpe (White-spotted Fly-

- catcher). "On April 3 one of these birds was seen by Odendaal to dart out from the trees at the edge of Chirinda at a butterfly (*Mylothris*) flying past a few feet away, but to turn back on reaching it without an attempt at capture": C. F. M. Swynnerton, "Ibis," 1908, p. 98 (Mashonaland).
10. *Terpsiphone perspicillata* Sw. (S. African Paradise Flycatcher). (a) "I have seen *Tchitreia cristata* darting at *P.* [*Mylothris*] *agathina*": J. P. Mansel Weale, "Nature," iii, p. 508 (Cape Colony).—(b) "I would notice that I have seen a *Tchitreia cristata* capture a [*Papilio*] *merope* ♂, and chase a *P. nireus*, and I have little doubt that this bird is most destructive to bush-frequenting Rhopalocera": J. P. Mansel Weale, Proc. Ent. Soc., 1874, p. 132 (Cape Colony).—(c) "March 28, 1897. While out collecting at Malvern, Durban, Natal, I saw a Paradise Flycatcher catch a specimen of *Eronia cleodora*": G. A. K. Marshall, Trans. Ent. Soc., 1902, p. 357.—(d) "While watching an *Atella phalantha* hovering over a bush of its food-plant, a Paradise Flycatcher darted past, and with a loud snap of its beak, tried to catch the butterfly in its swoop:" G. A. K. Marshall, *l. c.* (Rhodesia).
11. *Dicrurus afer*, Licht. (African Drongo). (a) "I have little doubt that . . . *Dicrurus musicus*, Vieill., is most destructive to bush-frequenting Rhopalocera": J. P. Mansel Weale, Proc. Ent. Soc. 1874, p. 132 (Cape Colony).—(b) "December 1, 1898. C. F. M. Swynnerton saw a drongo (*Buchanga assimilis*) fly past him with a white butterfly in its beak, probably *C. florella*": G. A. K. Marshall, *l. c.* p. 357 (Rhodesia).—(c) A drongo observed to attack a tattered *Belenois* (either *mesentina* or *severina*): G. A. K. Marshall, *l. c.* p. 357 (Rhodesia).—(d) "Gorongosa Dist., Portuguese E. Africa, May 1907. Although this species was common, I only once noticed it take butterflies, when one caught a small brown species that was passing where it was perched": C. H. B. Grant (note from diary).—(e) "I have on several occasions seen the common Drongo (*D. afer*) make more or less successful darts at passing butterflies" (N.E. Rhodesia): S. A. Neave (letter dated 19, ii, 1909).
12. *Dicrurus* sp. (Drongo). Colonel N. Manders tells me that in the harbour of Nossi Be, Madagascar, in 1907,

- he observed a drongo pursuing a butterfly (*Hypolimnas drucei*, Butl.) which it failed to capture.
13. *Dicrurus ludwigi*, Smith (Lesser Drongo). "16, viii, 1908. In the same locality as yesterday, viz., the edge of a patch of dense forest, saw a Lesser Drongo (*D. ludwigi*), catch a damaged *Catopsilia florella*": S. A. Neave (note from diary; N.E. of Lake Bangweolo).
 14. *Hirundo monteiri*, Hartl. (Monteiro's Swallow). "13, vi, 1908. N.E. of Lake Bangweolo. Saw a large swallow, probably *H. monteiri*, capture a *Teracolus ? evenina* which appeared to have been previously injured": S. A. Neave (note from diary).
 15. *Hirundo* sp. (Swallow). "I think I told you long ago of having found the wings of a lot of butterflies, chiefly *P. corinneus*, below the branch of a tree on which some swallows were constantly settling": C. F. M. Swynnerton, Tr. Ent. Soc., 1902, p. 358 (Gazaland).
 16. *Cypselus caffer*, Licht. (S. African Swift). Observed to "take small moths from the grass and dart at *Terias rahel* [*brigitta*, Cram.] on our open flats": J. P. Mansel Weale, "Nature," iii, p. 508. (Cape Colony.)
 17. *Dicrocercus hirundineus*, Licht. (Swallow-tailed Bee-Eater). "11, x, '07. I watched to-day for about half-an-hour a specimen of the Swallow-tailed Bee-Eater (*D. hirundineus*) hawking butterflies. As far as I could see he took nothing but Pierines, *C. [Catopsilia] florella* mostly, but one or two *B. [Belenois] nr. dentigera*, and one *Terias*" (N.W. Rhodesia): S. A. Neave (in a letter to Prof. Poulton).
 18. *Merops persicus*, Pall. (Blue-cheeked Bee-Eater). (a) "In the vicinity of every hole were numbers of pellets, formed of the wings and other indigestible parts of dragon-flies, butterflies, beetles, etc.": S. Stafford Allen, "Ibis," 1862, p. 359 (On the Nile).—(b) Mr. C. F. M. Swynnerton has recently sent me a butterfly which was taken from the stomach of one of these birds at Chibababa, Portuguese E. Africa, on December 11, 1906. The insect is an *Aeraca*, belonging to the group represented by *A. horta*, L., but is too much damaged for exact identification. The same gentleman notes the dexterity of these birds in catching insects, but states: "Yet I saw one strike

deliberately at a *Belenois* (of which the rapid erratic flight must be very puzzling to a bird) and miss it. I have noticed the same difficulty on the part of *Dicrurus afer*" ("Ibis," 1908, p. 398).

19. *Merops apiaster*, L. (European Bee-Eater). (*a*) I have recently received from Mr. C. F. M. Swynnerton the two front wings of an Hesperid (either a *Baoris* or *Platylesches*), which were taken from a stomach of this bird near Chirinda (3500 ft.), Gazaland, on March 26, 1907.—(*b*) "I have found a specimen of *Mylothris agathina* in the crop of the common 'Abelharuco' (*Merops apiaster*)": Dr. F. Creighton Wellmann, "Ann. Soc. Ent. Belg.," 1908, p. 148 (Angola).
20. *Merops nubicoides*, Desm. and P. (Carmine-throated Bee-Eater). Mr. C. H. B. Grant has kindly supplied me with the two following observations noted in his diary when in S.E. Africa.—(*a*) "Near Beira (Jan. 1907) I saw three of these birds together perched on the top of a dead tree, and when walking up to shoot them I distinctly saw one fly out and take a brown butterfly that was passing."—(*b*) "When travelling up the Zambesi from Tambara to Tette (Aug. 1907), a small flock of these birds was hawking over the water, and twice or three times I saw them catch white butterflies, of which there were quite a number about."
21. *Merops* sp. "All kinds of insects form the prey of these birds. Once I shot one with its mouth so stuffed with butterflies that it appeared to me marvellous that it had not choked": Capt. Boyd Alexander, "From the Niger to the Nile," vol. ii, p. 29 (N. Nigeria). [The bird was doubtless collecting food for its young, G. A. K. M.]
22. *Merops boehmi*, Reichen. (Böhm's Bee-Eater). "15, viii, 1908. Saw a Böhm's Bee-Eater make one or two attempts to catch butterflies, chiefly Pierines, but did not see him actually take one": S. A. Neave (note from diary; N.E. of Lake Bangweolo).
25. *Melittophagus meridionalis*, Sharpe (Little Bee-Eater).—(*a*) "I noticed one bird catch a white butterfly, but small coleopterous insects seem to form the chief part of their prey." Dr. A. Stark, in Stark and Sclater's "Birds of S. Africa," iii, p. 69 (Natal).—(*b*) Mr. Swynnerton has sent me the stomach of one of these birds which he shot in Melsetter District,

- Mashonaland, in October 1906. This contained two flies of the genus *Pyrgota* and one of the genus *Sarcophaga*, one beetle (*Onthophagus aeruginosus*, Roth.) and one butterfly (*Precis* sp.), far too much damaged for exact identification.—(c) “Luombwa R., near S.E. boundary of the Congo Free State. 13, xii, 1907. Saw a little Bee-Eater (*M. meridionalis*) catch and eat what appeared to be *Atella phalantha*, though it may possibly have been its mimic *Pseudargynnis hegemone*, as they are impossible to distinguish on the wing”: S. A. Neave (note from Diary).—(d) “Besides the above I have on several occasions seen *M. meridionalis* make more or less successful darts at passing butterflies”: S. A. Neave (letter dated 19, ii, 1909).
24. *Melittophagus bullockoides*, Smith (White-fronted Bee-Eater). At Chibababa, in Portuguese E. Africa, Mr. Swynnerton watched these birds hawking insects. “During the whole time that I was watching, perhaps a quarter of an hour, I saw the birds fly out six times after butterflies of some size, including Pierines, probably *Catopsilia florella* and *Belenois severina* or *B. mesentina*, as these seemed to be the only white butterflies which were flying over the water. In these six attempts the butterfly was caught outright only twice; on two other occasions, after much dodging, it got away and the bird returned to its perch; while on two remaining occasions, on one bird missing the insect, several others promptly flew out (the first time seven or eight, and the second time three) to join in the sport, the butterfly being eventually captured, each time after some little darting about and confusion. Besides this, on quite a number of occasions, I saw a bird aim at or catch what I took to be a Lycaenid, the others going out to its aid in the same manner three or four times”: C. F. M. Swynnerton, “Ibis,” 1908, p. 399. [He shot one bird and sent me the stomach, which contained a specimen of *Acraea rabbiae*, Ward, G. A. K. M.]
- 25 *Eurystomus afer*, Lath. (Yellow-billed Roller). “Masembeti, near Beira, Nov. 1906. This bird was sitting on a very tall dead tree, and I saw it take a large reddish or brown butterfly on the wing”: C. H. B. Grant (note from diary).

26. *Coracias caudatus*, L. (Lilac-breasted Roller). "Rollers (*Coracias caudata*) are great hawkers of flying insects, especially of butterflies": H. A. Bryden, "Nature and Sport in S. Africa," p. 64.
27. *Coracias* sp. "I may here say that I have on one occasion seen a Roller (*Coracias*) in West Africa capture on the wing a Pierine, probably *Terias senegalensis*": Dr. F. Creighton Wellman, "Ann. Soc. Ent. Belg.," 1908, p. 148.
28. *Ispidina natalensis*, Smith (Natal Kingfisher). "These birds feed entirely on butterflies and insects caught on the wing": T. Ayres, in Sharpe's "Monogr. Kingfishers," p. 146 (Natal).
29. *Haleyon chalcuti*, Stanley (Striped Kingfisher). (a) "Its food consists entirely of Coleoptera, Orthoptera, Lepidoptera and flies. . . . It captures insects on the wing": von Heuglin, quoted in Sharpe's "Monogr. Kingfishers," p. 184 (N.E. Africa).—(b) "Nov. 23, 1908. "Saw a Bush Kingfisher catch and eat two butterflies, viz. *Junonia cebrene* and *Catopsilia florella*, both of which were captured when feeding." G. A. K. Marshall, Tr. Ent. Soc., 1902, p. 357 (Rhodesia).
30. *Coccytes cafer*, Licht. (Levaillant's Cuckoo). "Dec. 15, 1898. Remains of *Papilio demodocus* found in the stomach of a cuckoo (*Coccytes cafer*)": G. A. K. Marshall, *l. c.* (Rhodesia).
31. *Falco subbuteo*, L. (Hobby), "Swynnerton shot a hobby which had in its stomach an almost complete *Terias*": G. A. K. Marshall, *l. c.* (Rhodesia).
32. Birds not identified:—
 (a) "Empandeni, Plumtree, Rhodesia. On Feb. 31 of this year (1907) I was passing through a native field and saw a brownish bird about the size of a starling dart out of a tree and seize a *Pieris* or *Teracolus* (I could not be certain which, as the butterfly was flying rather high and I was not near enough to identify it) in its beak and fly back to the tree with it. I was near enough to be absolutely certain of this. It was the first time I had ever witnessed anything of the sort, and so far I have not seen a repetition of any such attack": Father O'Niel, S. J. (*in litt.*).—
 (b) "This *Salamis* was settled on the under-side of a leaf when a bird made a dart at it and took the piece out of the wings. May 12, 1902, Stella Bush, Dur-

ban": note by F. Muir on a specimen of *S. anacardii* (= *parhassus*, Drury) in the Oxford Museum. Prof. Poulton, to whom I am indebted for this record, says, that a huge piece, probably over one-third, is taken symmetrically out of both hind-wings.—(c) "I have only once seen a bird attempt the capture of a butterfly, and that was a shrike, which is common here, trying to catch a newly emerged *Charaxes*": Rev. K. St. Aubyn Rogers, in a letter to Prof. Poulton dated Taveta, B. E. Africa, July 5, 1905.—(d) "On May 18, 1908 [at Durban, Natal], I followed up a ♀ *Charaxes neanthes* and obtained eighteen ova, and should have got more, but the fly was then captured by a bird." G. F. Leigh (in a letter to Prof. Poulton, dated 12, ix, 1908).—(e) Mr. F. Muir "expressed surprise that any doubts should have been raised. He had frequently observed such attacks at Delagoa Bay and other places on the East Coast of Africa, and had seen birds waiting in trees or bushes and darting out at butterflies as they approached": Prof. E. B. Poulton, "Essays on Evolution," p. 282, note.

The following is a summary of the butterflies attacked:—

ETHIOPIAN BUTTERFLIES.

ACRAEINAE.

Acraea sp.—*Motacilla capensis* (1, a); *Merops persicus* (18, b).

A. rabbaiae, Ward.—*Melittophagus bullockoides* (24).

A. nohara-halali, Mshl.—*Apalis thoracica* (4).

NYMPHALINAE.

Atella phalantha, Drury.—*Terpsiphone perspicillata* (10, d); *Melittophagus meridionalis* (23, c).

Pyrameis cardui, L.—*Nectarinia* sp. (3).

Precis sp.—*Melittoph. meridionalis* (23, b).

P. hierta-cebrene, Trim.—*Halcyon chelicuti* (29, b).

Salamis parhassus, Drury.—Bird (32, b).

Hypolimnas dubius-drucei, Butl.—*Dicrurus* sp. (12).

Charaxes sp.—Bird (32, c).

C. neanthes, Hew.—Bird (32 d).

LYCAENINAE.

Tarucus telicanus, Lang.—*Pratincola torquata* (5); *Pachypora molitor* (8, a, b).

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PIERINAE.

Mylothris sp.—*Trochocercus albonotatus* (9; butterfly refused).

M. agathina, Cram.—*Terpsiphone perspicillata* (10, *a*); *Merops apiaster* (19, *b*).

Belenois spp.—*Merops persicus* (18, *b*); *Dicrurus afer* (11, *c*).

B. near *dentigera*, Butl.—*Dicrocercus hirundineus* (17).

Synchloe helice, L.—*Motacilla capensis* (1, *b*).

Eronia cleodora, Hübn.—*Terpsiphone perspicillata* (10, *c*).

Catopsilia florella, F.—*Dicrurus afer* (11, *b*); *Dicrurus ludwigi* (13); *Dicrocercus hirundineus* (17); *Halcyon chelicuti* (29, *b*).

Teracolus ? evenina, Wallg.—*Hirundo monteiri* (14).

Terias sp.—*Dicrocercus hirundineus* (17); *Falco subbuteo* (31).

T. brigitta, Cram.—*Cypselus caffer* (16).

T. senegalensis, Boisd.—*Coracias* sp. (27).

Pierinae.—*Merops nubicoides* (20, *b*); *Merops boehmi* (22); *Melittophagus meridionalis* (23, *a*); *M. bullockoides* (24); *Bird* (32, *a*).

PAPILIONINAE.

Papilio demodocus, Esp.—*Coccystes cafer* (30).

P. dardanus-cenea, Stoll.—*Terpsiphone perspicillata* (10, *b*).

P. nireus-lyaeus, Doubl.—*Lanius collaris* (6); *Terps. perspicillata* (10, *b*).

P. pylades-angolanus, Goeze.—*Hirundo* sp. (15).

HESPERIIDAE.

Sarangesa eliminata, Holl.—*Bradyornis mariquensis* (7).

Baoris detecta, Trim.—*Pachyrora molitor* (8, *b*).

Hesperidae.—*Merops apiaster* (19, *a*).

RECORDS FROM THE INDO-MALAYAN REGION.

1. *Copsychus saularis*, L. (Dhayal Bird). "I remember once seeing at Dehra Dun a Dhyal or Magpie-Robin take a disabled *Catopsilia* I threw out for it": Frank Finn, "Nature," lxi, 1899, p. 55 (India).
2. *Pycnonotus* sp. (Bulbul). "The Hon. Mr. Justice Newton, who assiduously collected and took notes

- upon the Lepidoptera of Bombay, informed me that the *Charaxes psaphon* of Westwood was continuously persecuted by the Bulbul": A. G. Butler, "Nature," iii, 1870, p. 165, note.
3. *Pycnonotus sinensis*, Gm. (Green Bulbul). Observed to attack butterflies in Southern China, "but generally miss them": J. C. Kershaw, Tr. Ent. Soc. Lond. 1905, p. 6.
 4. *Otocampsa fuscicaudata*, Gould (Red-whiskered Bulbul). "This afternoon I was sitting under the veranda with my head within about 5 ft. of a red-whiskered bulbul's nest containing two young birds about five days old. One of the parent birds arrived with the very last butterfly I should have expected it to have any dealings with, viz. *Acraea violae*. . . . I noticed that the butterfly was well in the bird's bill, firmly held, with the wings in considerable disarray. The body must have been fairly well crushed, so that the bulbul must have been fully alive to the flavour. I put my head within about 3 ft. of the nest to see how the young birds took it. The bird went down and pushed the butterfly well into the youngster's throat, and it was swallowed immediately, wings and all, and the young bird settled quietly down without seeming in the slightest degree upset": H. L. Andrewes (in a letter to Prof. Poulton, dated 19, iii, '08, Nilgiri Hills, S. India).
 5. *Artamus monachus*, Bp. (Swallow-Shrike). "It feeds on insects, butterflies on the wing, grasshoppers, etc. (Meyer)": Meyer and Wigglesworth, "Birds of Celebes," ii, p. 435.
 6. *Artamus fuscus*, Vieill. (Ashy Swallow-Shrike). "I am not certain as to the date on which I saw the Ashy Swallow-Shrike catching specimens of the Euploea, *Crastia core*. . . . At least six specimens of the *Crastia* were captured by the shrike, all of which it carried away to a branch high up in a big tree, but I could not see whether they were eaten": Col. J. W. Yerbury, Tr. Ent. Soc. Lond., 1902, p. 360.
 7. *Tephrodornis pondicerianus*, Gm. (Indian Wood-Shrike). "Moths and small butterflies form a considerable portion of its food": Capt. Legge, "Birds of Ceylon," ii, p. 374.
 8. *Chibia hottentotta*, L. (Hair-crested Drongo). "Salween

River, 17, v, 78. . . . This tree [*Bombax malabaricum*] was in flower and was crowded with birds of all kinds, chiefly mainas, kingcrows and parrots. I noticed among them two or three hair-crested Drongos (*Chibia hottentotta*), and was rather surprised to see one of these suddenly dart from the tree and give chase to a white butterfly (*Appias hippo*) that was flitting about some willow-like bushes. The bird swooped at the butterfly several times and chased it, but so far as I could see did not succeed in catching it": Lt.-Col. C. T. Bingham, note from diary (Burma).

9. *Dicrurus ater*, Herm. (King-Crow).—(a) "It feeds . . . occasionally on moths and butterflies": Jerdon, "Birds of India," i, p. 428.—(b) "Delhi, 11, vii, 75. . . . While I was watching a *Papilo erithonius* [= *demoleus*, L.] flew past and the King-Crow gave chase, snapped at it, but the butterfly dodged, the bird twisted, and after making two or three more attempts caught it and flew with it to a small keekur tree (*Acacia*). For some time the King-Crow sat holding the butterfly, then he began to champ it and seemed to make two or three attempts at swallowing. A villager, however, coming through the grass close past the tree frightened the bird and it dropped the butterfly. I picked the insect up, but though still alive it was much injured and unable to fly": Lt.-Col. C. T. Bingham (note from diary).—(c) This bird was observed to catch butterflies in India: Major Nurse, "Journ. Bombay, N. H. Soc.," ix, 1895, p. 337.—(d) The common King-Crow (*Dicrurus ater*, I believe) invariably captures butterflies on the wing; I have seen these birds scores of times do this. Their usual prey seems to be a small deep yellow butterfly with black on the tip of the wings, but I have occasionally seen other butterflies so captured by them. . . . With reference to my previous letter I would say that the butterfly referred to was the *Terias silhetana* or *Terias lacta*, probably both": A. E. Mackay, "Nature," lxx, 1902, pp. 247 and 486 (India).—(e) "In the other case the butterfly, *Euthalia garuda*, had been slightly crippled by some accident, which a King-Crow detected at once, but it had some trouble to catch it": E. H. Aitken, "J. Bomb. N. H. Soc.," xvi, 1904, p. 156 (India).—(f) Observed to attack butterflies in Southern China, but generally

- miss them: J. C. Kershaw, Tr. Ent. Soc., 1905, p. 6.—(g) "Sept. 23, 1885. Road up Thundiani, near Kala Pani Bungalow. Saw a young King-Crow, *Dicrurus ater*, stoop at a big blue *Papilio*, either *P. polyctor* or *P. arcturus*, and miss it. The bird did not repeat the attempt": Col. J. W. Yerbury, Tr. Ent. Soc., 1902, p. 359.—(h) "Sept. 2, 1886. Road up Thundiani, near top of the hill. Saw a young King-Crow stoop at a specimen of *Vanessa kaschmirensis*, and after missing it once take it at the second attempt. Did not notice whether the insect was eaten": Col. Yerbury, *l. c.*—(i) "Going through some fairly open jungle [in Burma] close to the main road I put up a *Melanitis zitenius*, which fluttered across the road and was swooped at by a King-Crow (*Dicrurus*), but missed": Lt.-Col. C. T. Bingham, Tr. Ent. Soc., 1902, p. 363.—(j) Observed to hawk *Catopsilia* in Burma: Lt.-Col. Bingham, *l. c.* p. 363.
10. *Dicrurus* sp. (Drongo). "On a forest path a *Danaus septentrionalis* flew along before me with its slow, flapping motion, when suddenly an apparently young Dicrurid—these birds are bitter enemies of butterflies—darted at it from a twig where it had been on the watch, but when about two feet away shook itself and then, without seizing the insect, returned to its perch": E. Haase, "Res. on Mimicry," p. 99 (Siam).
 11. *Dicrurus longicaudatus*, Jerd. (Long-tailed Drongo). This bird was observed to seize a large butterfly (*Teinopalpus imperialis*, Hope) on the wing: G. C. Dudgeon, "J. Bomb., N. H. Soc.," ix, 1895, p. 337 (India).
 12. *Dicrurus leucopygialis*, Blyth (White-vented Drongo). "Mr. Lewis also gives *Buchanga leucopygialis* as a very active hunter of butterflies on the wing": R. Trimen, Proc. Ent. Soc., 1897, p. xci (Ceylon).
 13. *Dicrurus* sp. On two occasions in Java an "*Edolius?* sp." was seen to eat a *Euploca rafflesii*, Moore (Piepers): A. S. Packard, "Proc. Am. Phil. Soc.," 1904, p. 412.
 14. *Buchanga* sp. (Drongo). "*Buchana* [sic] sp., a small species, was very common on a small island near Bangkok during the flying season of the *Catopsiliae*, and I have observed it as it was busy in capturing these insects." Haase also states that Dicruridae in general "appear to be special enemies of these

- insects [butterflies]": E. Haase, "Researches on Mimicry," (transl.), ii, p. 101.
15. *Pericrocotus flammeus*, Forst. (Orange Minnivet). "Its diet consists of small butterflies and various winged insects, some of which it will occasionally take on the wing": Capt. Legge, "Birds of Ceylon," ii, p. 365.
 16. *Terpsiphone princeps*, Temm. (Black-tailed Paradise Flycatcher). Observed to attack butterflies but generally miss them, in Southern China: J. C. Kershaw, Trans. Ent. Soc., 1905, p. 6.
 17. *Terpsiphone paradisi*, L. (Indian Paradise Flycatcher). Observed to catch *Neptis acris*, *Ixias marianne* and *Eurema* [*Terias*] *hecabe*, Jan. 1905, at Vavuniya Vilankulam, North Ceylon: Dr. F. Doflein (letter dated 12, iv, '07).
 18. Flycatcher (not identified). "Often and often I have had opportunities of observing females of *Clerome faunula* fall a prey to flycatchers when sailing round the tops of trees with their slow fluttering flight": A. Grubauer, "Soc. Ent. Zurich," xvii, 1902, p. 123 (Malay Peninsula).
 19. *Passer montanus*, L. (Tree Sparrow). (a) "Twice also have I seen a sparrow attack an *Amathusia phidippus*, L.": Piepers, quoted by Packard, "Proc. Am. Phil. Soc.," 1904, p. 412 (Java).—(b) "I have observed *Hesperia thrax* and other Hesperidae and *Catopsilia*, which were struck down and devoured by sparrows": E. Haase, "Researches on Mimicry" (transl.), ii, p. 101 (Siam).—(c) Observed to attack butterflies, but generally miss them, in Southern China: J. C. Kershaw, Trans. Ent. Soc. Lond., 1905, p. 6.—(d) "I have more than once noticed the common Burmese sparrow (*Passer montanus*) trying to catch some little moth. On one occasion I watched the insect, which had escaped, settle, and caught it. It proved to be a *Zizera* sp.?" : Lt.-Col. C. T. Bingham (note from diary).
 20. *Acridotheres tristis*, L. (Common Mynah). (a) "Kaw-karaik, 18, iv, 1891. Saw a maina (*A. tristis*) while feeding on the ground in front of my bungalow make a sudden jump upwards to catch a passing *Papilio*; what species the latter was I did not see": Lt.-Col. C. T. Bingham (note from diary).—(b) "I may mention that not long ago I saw here in Calcutta a

- Common Mynah with a white butterfly in its bill": F. Finn, "Nature," lxi, 1899, p. 55.
21. A Trogon (not identified). "The other day I saw a small Trogon dart at a *Terias* unsuccessfully": S. B. J. Skertchley, "Ann. Mag. N. H." (6) iii, 1889, p. 478 (Borneo).
 22. *Merops viridis*, L. (Indian Bee-Eater). (a) Observed to catch butterflies in India: Major Nurse, "J. Bomb. Soc.," xv, p. 349.—(b) "Col. Swinhoe informs me that in India he has on several occasions seen *Merops viridis* catch and eat butterflies, and that he has also witnessed many cases of other birds pursuing them": R. Trimen, Proc. Ent. Soc. Lond., 1897, p. xc.—(c) "Mr. F. Lewis, of the Ceylon Forest Service, . . . has seen *Merops viridis* occasionally take small white and yellow butterflies (*Terias* spp.)": R. Trimen, *l. c.* xci.—(d) "In the cases [of birds attacking butterflies which] he had witnessed, the *Euplocae* and *Danaidae* were caught as often as any others, but usually escaped eventually from the beak of the bird and flew away none the worse owing to the toughness of the integuments. The only bird he had observed frequently to pursue butterflies was the Common Indian Bee-Eater, which he had seen hawking *Pieridae*, and among them *Teracolus*": Sir G. Hampson, Proc. Ent. Soc. Lond., 1897, p. xxxviii (India).—(e) "Another bird that frequently catches these butterflies [*Terias silhetana* and *T. lacta*] on the wing is the Indian Bee-Eater (*Merops viridis*)": A. E. Mackay, "Nature," lxxv, 1902, p. 486 (India).—(f) "In one case a Bee-Eater caught a *Danaïs*, but dropped it as soon as it had tasted it, and the *Danaïs* flew away little the worse": E. H. Aitken, "J. Bomb. Soc.," xvi, 1904, p. 156 (India).—(g) *Terias hecabe* and *Papilio pammon* "seemed to be the principal victims of the graceful green Bee-Eaters. . . . They never missed their prey, and always brought their quarry back to the same spot to be dis-winged before being swallowed, the ground under their watch-towers being thickly strewn with gaily painted shreds of unfortunate butterflies and bees": E. L. Arnold, "On the Indian Hills," i, pp. 247, 248 (1881).—(h) Col. N. Manders informs me that in the year 1900 in Ceylon he observed a Bee-Eater of this species capture a *Charaxes pasiphon*.

23. *Merops philippinus*, L. (Philippine Bee-Eater). (a) "Mr. F. Lewis, of the Ceylon Forest Service, . . . has seen *M. philippinus* occasionally take small white and yellow butterflies (*Terias* spp.): R. Trimen, Proc. Ent. Soc. Lond., 1897, p. xci.—(b) "Frequently capture *Catopsilia*, especially when these butterflies are travelling in thousands along the river-valleys" (F. Lewis): R. Trimen, *l. c.* (Ceylon).—(c) "They feed even on butterflies, which I have seen this species frequently capture": Jerdon, "Birds of India," I, p. 208 (2nd ed. 1877).—(d) "Nov. 14, 1891. On the Kandy Road between Trinkomali and Kanthalai; butterflies in great numbers sitting on the wet mud by the roadside; chiefly Pierinae (*Catophaga*), but a few *P[apilio]* *nomius* with them. These butterflies rose in clouds as one drove past. A Bee-Eater, *Merops philippinus*, kept flying in front of my carriage and taking specimens of these butterflies as they rose. The bird seemed to select the yellow females, which are rare, the white females being to them probably in the proportion of 100 to 1. . . . These Bee-Eaters were often seen catching Pierinae; in fact, it seems to have occurred so often that I ceased to record the fact": Col. J. W. Yerbury, Trans. Ent. Soc., Lond., 1902, p. 360.—(e) "I noticed clouds of butterflies, chiefly *Catopsilia*, migrating, crossing the Salween from east to west in a continuous stream. These were being persistently hawked by the *Merops*, mixed with which were some king-crows": Lt.-Col. C. T. Bingham, Trans. Ent. Soc. Lond., 1902, p. 363 (Burma).
24. *Merops viridis*, L., *M. philippinus*, L., and *Melittophagus swinhoei*, Hume. (a) Some Bee-Eaters ("which of the three species mentioned in my book was not sufficiently determined") were seen to capture *Papilio erithonius*, *P. hector* and *Precis iphita*, at Anaradhapura, Ceylon, in Jan. 1905: Dr. F. Dofflein (letter dated 12, iv, 1907).—(b) At Vavuniya Vilankulam, North Ceylon, in Jan. 1905, all these three Bee-Eaters were observed to capture some of the following butterflies, *Papilio erithonius*, *P. hector*, *Hypolimnas bolina*, *H. misippus*, *Eronia spiculifera*, and *Hebemoia glaucippe*: Dr. Dofflein, *l. c.*
25. *Merops apiaster*, L. (European Bee-Eater). Seen to capture a Lycaenid, probably *Polyommatus (Lampides)*

- bacticus* : Major Nurse, "Journ. Bomb. Soc.," xv, p. 349 (India).
- 25 bis. *Merops leschenaulti*, Vieill. (Leschenault's Bee-Eater). "These birds never eat the wings of butterflies. You see one of them swoop on to a butterfly close at hand; then you hear a little click of the bill, and as the bird flies off the pair of wings come slowly fluttering to the ground": W. Davison, "Stray Feathers," vi, 1878, p. 68.
26. *Melittophagus swinhoei*, Hume (Swinhoe's Bee-Eater). (a) "Frequently capture *Catopsiliae*, especially when these butterflies are travelling in thousands along the river-valleys" (F. Lewis): R. Trimen, Proc. Ent. Soc. 1897, p. xci (Ceylon).—(b) "The butterflies hawked and eaten by the Bee-Eaters belong to the following species, *Papilio erithonius*, *P. sarpedon*, *Charaxes athamas*, *Cyrestis thyodamas*, and *Terias hecabe*. A meagre list, for I am certain I saw the Bee-Eaters swoop for and catch *Prioneris*, *Hebomoia*, *Junonia* and *Precis*. I also particularly noticed that the birds never went for a *Danaïs* or *Euploea*, or for *Papilio macareus* and *P. xenocles*, which are mimics of *Danaïs*, though two or three species of *Danaïs*, four or five of *Euploea*, and the two above-mentioned mimicking Papilios simply swarmed along the whole road": Lt.-Col. C. T. Bingham, Trans. Ent. Soc., 1902, p. 362 (Burma).
27. *Coracias indicus*, L. (Indian Roller). Observed catching butterflies in India: Major Nurse, "J. Bomb. Soc.," xv, p. 349.
28. *Coracias affinis*, McCl. (Burmese Roller). "Ataran River, 30, ii, 1881. Saw a *Coracias affinis* fly to a tree holding a *Cyrestis thyodamas* in its mouth" Lt.-Col. C. T. Bingham (note from diary).
29. *Halcyon smyrnensis*, L. (White-breasted Kingfisher). (a) "Very common, feeding indiscriminately on fresh- or salt-water fish, crabs, beetles and butterflies. I have seen them capture these last in the manner of flycatchers (Muscicapidae), darting from a sprig and seizing them in the air": E. L. Layard, "Ann. Mag. N. H." (2) xii, 1853, p. 172 (Ceylon).—(b) "I have observed one launch out from a high tree, in the manner described by Layard, on a butterfly": Capt. Legge, "Birds of Ceylon," i, p. 300 (1878).

30. *Microhierax fringillarius*, Drap. (Black-legged Falconet). (a) On 25 March, 1877, in Tenasserim, a nest of this species was found in a hole in a tree. "At the bottom of the hole, which was about eighteen inches deep, was a soft pad composed of flies and butterflies' wings, mixed with small pieces of rotten wood": J. Davidson, quoted by A. O. Hume, "Stray Feathers," v, 1877, p. 81.—(b) This Falconet was observed hawking *Papilio empedocles* at Sarawak, Borneo, in Sept. 1897: R. Shelford (*in litt.*).—(c) "Though feeding on birds, as a rule smaller, but undoubtedly occasionally larger than itself, the chief food probably of this little Falcon is insects of various sorts, dragonflies, beetles and butterflies. I say butterflies, for, although I have never found the distinguishable remains of butterflies in those I have examined, I have no doubt that they do capture butterflies largely, and of all sizes, for the nest of a pair that I found at Bankasoon [Burma] consisted of a pad composed entirely of insect-wings, and the mass of these were those of butterflies": W. Davison, "Stray Feathers," vi, 1878, p. 5.
31. *Microhierax coerulescens*, L. (Red-legged Falconet). (a) This bird was observed on March 20, 1881, in Burma, to capture and eat a *Papilio sarpedon*: Lt.-Col. C. T. Bingham, Trans. Ent. Soc., 1902, p. 364.—(b) From a nest of this species found in Burma in March 1878, the following butterflies' wings were taken—*Mycalesis perseus*, *Precis orithya*, *Symphaedra dirtea* ♀, *Charaxes* sp., *Papilio erithonius*, *Papilio caunus*, and some unidentified species of Lycaenidae: Lt.-Col. Bingham, *l. c.* p. 365.—(c) Another nest of the same species, also found in Burma, contained "a fairly firm pad of chips of wood, a few leaves, with an upper stratum quite two inches thick, composed almost entirely of the wings of cicadas, with a few butterfly and moth wings interspersed therein": Lt.-Col. Bingham, "Zoologist" (4), 1901, p. 224.
32. Birds not identified:—
 (a) A specimen of the Lycaenid, *Panchala apidanus*, was certified by Mr. Godfery to have been mutilated by a bird: W. L. Distant, "Rhop. Malayana," p. 274.—(b) "I have never seen a bird seize one of the often very common, slow-moving and fearless, reddish-brown

Danaids; while the Pieridae, and especially the *Catopsiliae*, were often pursued by birds a long distance": E. Haase, "Researches on Mimicry" (transl.), ii, p. 23, note.—(c) A bird was seen to seize a butterfly, *Elymnias undularis* ♂, just as the observer was on the point of capturing it with his net: Prof. E. A. Minchin, Proc. Ent. Soc. L., 1904, p. xxxvii. (India.)—(d) "During five years I have, perhaps, seen a dozen attacks on butterflies by birds, and only seen them captured two or three times": J. C. Kershaw, Trans. Ent. Soc., 1906, p. 6 (S. China).—(e) "In Ceylon a bird was seen to make a swoop at a male *Catophaga paulina*, but missed it": Dr. G. B. Longstaff, Trans. Ent. Soc., 1905, p. 135.—(f) "I have often seen birds catch butterflies in Hongkong, Cochin-China, and Europe, but neither birds nor butterflies were identified": Dr. F. Doflein (letter dated 22, iv, 1907).—(g) "Hangtharaw River, 12, iv, 1881 [Burma]. On the march to-day I found under a tree by a stream quite a number of the wings of butterflies, chiefly *Lycaenidae*. These had apparently been sheared off by some bird that had fed on the flies. *Lampides* and *Nacaduba* abounded on the sandy banks": Lt.-Col. Bingham (note from diary).—(h) "I could never observe that this species [*Ornithoptera darsius*, Gray] was captured by the birds, though the much larger black and white *Papilio polymnestor*, Cram., often fell a prey to them, and nearly all those on the wing were damaged." It is then suggested that the *Ornithoptera* derives its immunity from the fact that its larva feeds on the poisonous *Aristolochia*. "But be that as it may, we always observe that this butterfly is uninjured, in spite of its slow, lazy and almost unwieldy flight among the birds; while the strong, quickly flying *Papilios*, *hector*, *erithonius*, *agamemnon*, *montanus*, *polytes*, etc., are seized": Dr. F. Doflein, "Ostasienfahrt," p. 444 (Ceylon).

INDO-MALAYAN BUTTERFLIES.

DANAINAE.

Danaida sp.—*Merops viridis* (22, f; butterfly rejected).
Tirumala septentrionis, Butl.—*Dicrurus* sp. (10; butterfly refused).

Euploea cora, Cram.—*Artamus fuscus* (6).

E. rafflesii, Moore.—*Dicrurus* sp. (13).

SATYRINAE.

Mycalesis perseus, F.—*Microhierax coerulescens* (31, *b*).

Melanitis zitenius, Hbst.—*Dicrurus ater* (9, *i*).

Elymnias undularis, Drury.—Bird (32, *c*).

AMATHUSIINAE.

Melanocyma faunula, Westw.—Flycatcher (18).

Amathusia phidippus, Joh.—*Passer montanus* (19, *a*).

ACRAEINAE.

Acraga violae, F.—*Otocampsia fuscicaudata* (4).

NYMPHALINAE.

Pyrameis kaschmirensis, Koll.—*Dicrurus ater* (9, *h*).

Precis, spp.—*Melittophagus swinhoei* (26, *b*).

P. orithya, L.—*Microhierax coerulescens* (31, *b*).

P. iphita, Cram.—*Merops* sp. (24, *a*).

Hypolimnas bolina, L.—*Merops* sp. (24, *b*).

H. misippus, L.—*Merops* sp. (24, *b*).

Cyrestis thyodamas, Boisd.—*Melittophagus swinhoei* (26, *b*); *Coracias affinis* (28).

Neptis eurynome, Westw.—*Terpsiphone paradisi* (17).

Euthalia garuda, Moore.—*Dicrurus ater* (9, *e*).

Symphacdra dirtaea, F.—*Microhierax coerulescens* (31, *b*).

Charaxes sp.—*Microhierax coerulescens* (31, *b*).

C. psaphon, Westw.—*Pycnonotus* sp. (2); *Merops viridis* (22, *h*).

Eulepis athamas, Drury.—*Melittophagus swinhoei* (26, *b*).

LYCAENINAE.

Lampides bacticus, L.—*Merops apiaster* (25).

Zizera sp.—*Passer montanus* (19, *d*).

Panchala apidanus, Cram.—Bird (32, *a*).

Lycaenidae.—*Microhierax coerulescens* (31, *b*).

PIERINAE.

Prioneris sp.—*Melittophagus swinhoei* (26, *b*).

Ixias marianne, Cram.—*Terpsiphone paradisi* (17).

Appias hippo, Cram.—*Chibia hottentotta* (8).

Catopthaga sp.—*Merops philippinus* (23, *d*).

C. paulina, Cram.—Bird (32, *e*).

Catopsilia spp.—*Copsychus saularis* (1); *Dicrurus ater* (9, *j*); *Buchanga* sp. (14); *Passer montanus* (19, *b*); *Merops philippinus* (23, *b, c*); *Melittophagus swinhoei* (26, *a*).

Terias, spp.—Trogon (21); *Merops viridis* (22, *e*); *M. philippinus* (23, *a*).

T. hecabe, L.—*Terpsiphone paradisi* (17); *Merops viridis* (22, *g*); *M. philippinus* (23, *b*).

T. luctu, Boisd. (or *silhetana*, Wall.)—*Dicrurus ater* (9, *d*); *M. viridis* (22, *e*).

Teracolus sp.—*M. viridis* (22, *d*).

Hebomoia glaucippe, L.—*Merops* sp. (24 *b*); *Melittophagus swinhoei* (26, *b*).

Pareronia ceylanica, Feld.—*Merops* sp. (24, *b*).

Pierinae—*Acridotheres tristis* (20, *b*); *Merops viridis* (22, *d*).

PAPILIONINAE.

Teinopalpus imperialis, Hope.—*Dicrurus longicaudatus* (11).

Papilio sp.—*Acridotheres tristis* (20, *a*).

P. hector L.—*Merops* sp. (24, *a, b*).

P. demoleus, L.—*Dicrurus ater* (9, *b*); *Merops* sp. (24, *a, b*); *Melittophagus swinhoei* (26, *b*); *Microhierax coerulescens* (31, *b*).

P. polymnestor, Cram.—Bird (32, *h*).

P. polytes, L.—*Merops viridis* (22, *g*).

P. caunus, Westw.—*Microhierax coerulescens* (31, *b*).

P. polyctor, Boisd. (or *arcturus*, Westw.)—*Dicrurus ater* (9, *g*).

P. nomius, Esp.—*Merops philippinus* (23, *d*).

P. sarpedon, L.—*Melittophagus swinhoei* (26, *b*); *Microhierax coerulescens* (31, *a*).

P. empedocles, F.—*Microhierax fringillarius* (30, *b*).

HESPERIIDAE.

Casyapa thrax, L.—*Passer montanus* (19, *b*).

RECORDS FROM THE NEARCTIC REGION.

1. *Turdus migratorius*, L. (American Robin). Observed to attack and devour a large brown butterfly, but the wings were not eaten: G. A. Soper, "Nature," lxi, 1900, p. 49 (New Jersey).

2. *Turdus mustelinus*, Gm. (American Wood-Robin). *Colias philodice*, *Pieris rapae* and *P. brassicae* are eaten by this bird: Gentry, "Life-Histories of Birds of E. Pennsylvania," 1876, i, p. 16.
3. *Sialia sialis*, L. (Blue-bird). "They [an immense concourse of *Terias lisa*, Boisd.] did not stay long upon the islands [Bermudas], however, only a few days, but during that time thousands must have fallen victims to the vigorous appetites of the blue-bird (*Sialia sialis*, Baird), and black-bird (*Mimus carolinensis*, Gray), which were continually preying upon them": J. M. Jones, "Psyche," i, p. 122.
4. *Mimus polyglottus*, L. (Mocking-bird). (a) "In Florida, as we have been informed by Mrs. Annie T. Slosson, the mocking-bird frequently chases butterflies": A. S. Packard, "Proc. Am. Phil. Soc. 1904," p. 401.—(b) "Diptera, mosquitoes, butterflies, larvae of non-irritating properties, earthworms and berries of divers kinds constitute their dietary": Gentry, "Life-Histories of Birds of E. Pennsylvania," i, p. 27.
5. *Mimus carolinensis*, L. (Cat-bird). Observed to prey largely on *Terias lisa*, Boisd. (v. *Sialia sialis*).
6. *Telmatodytes palustris*, Baird (Long-billed Marsh Wren). Its food comprises among other things "many of the Noctuidae and Lycaenidae in the condition of imagoes": Gentry, *op. cit.* i, p. 89.
7. *Myiodyctes pusillus*, Wils. (Green Black-capped Flycatcher). Stomachs contained *Colias philodice*: Gentry, *l. c.* i, p. 168.
8. *Setophaga ruticilla*, L. (American Redstart). (a) Stomachs contained Lycaenidae: Gentry, *l. c.* i, p. 173.—(b) "The redstart feeds exclusively on an insect diet, consisting chiefly of flies, spiders, plant-lice, butterflies, beetles and different larvae": Dr. B. H. Warren, "Birds of Pennsylvania" (2nd ed.), p. 191.
9. *Dendroeca virens*, Gm. (Black-throated Green Warbler). Observed to have pursued and probably captured a *Pieris*, "apparently *Pieris rapae*": A. S. Packard, "Proc. Am. Phil. Soc.," 1904, p. 397 (U.S.A.).
10. *Geothlypis trichas*, L. (Maryland Yellow-throat). "Prof. C. V. Weed, of Durham, N.H., writes that he saw an *Antiope* butterfly in the mouth of a Maryland Yellow-throat": A. S. Packard, *l. c.* p. 401.
11. *Pyrranga rubra*, Sw. (Scarlet Tanager). (a) A butterfly

- found in one stomach: Dr. B. H. Warren, "Birds of Pennsylvania," p. 251.—(b) In stomachs of this bird were found "many of the Satyridae, Lycaenidae and Tortricidae": Gentry, *l. c.* i, p. 180.
12. *Hirundo erythrogaster*, Bodd. (American Swallow). Stomachs contained Lycaenidae: Gentry, *l. c.* i, p. 187.
 13. *Progne subis*, Baird (American Purple Martin). "Mr. Otto Widman, who has observed the feeding habits of purple martins, found that the parent birds carried to their nestlings dragonflies, butterflies and moths, grasshoppers, beetles and flies": S. D. Judd, "Yearb. Dept. Agric. Washing.," 1897, p. 417.
 14. *Tachycineta bicolor*, Vieill. (American White-bellied Swallow). Stomachs contained *Pieris rapae* and *Colias philodice*: Gentry, *l. c.* i, p. 189.
 15. *Cotile riparia*, L. (Sand Martin). Stomachs contained Lycaenidae: Gentry, *l. c.* i, p. 196.
 16. *Stelgidopteryx serripennis*, Aud. (Rough-winged Swallow). Stomachs contained *Colias philodice*, the smaller *Argynnis* and Lycaenidae: Gentry, *l. c.* i, p. 197.
 17. *Vireo olivaceus*, L. (Red-eyed Vireo). "Prof. F. E. L. Beal found in the stomachs of some nestling birds, tree-hoppers, assassin bugs [Reduviidae], spiders, sphinx caterpillars and butterflies": S. D. Judd, "Yearb. Dept. Agric. Washing.," 1897, p. 416.
 18. *Vireo flavifrons*, Vieill. (Yellow-throated Vireo). Observed to have eaten *Thecla humuli*, Harr. and *Argynnis bellona*, F.: Gentry, *l. c.* i, p. 221.
 19. *Vireo solitarius*, Wils. (Blue-headed Vireo). Eats "small Lepidoptera, both diurnal and nocturnal": Gentry, *l. c.* i, p. 226.
 20. *Vireo noveboracensis*, Gm. (White-eyed Vireo). Devours *Argynnis myrina* and *Thymele (Eudamus) tityrus*, F.: Gentry, *l. c.* i, p. 231.
 21. *Lanius ludovicianus*, L. (Loggerhead Shrike). "Its food consists chiefly of grasshoppers, crickets, Coleopterous and other insects, including butterflies and moths, which it will pursue and capture on the wing": Dr. Bachman, quoted by Baird, Brewer and Ridgway, "Birds of N. America," i, p. 419.
 22. *Melospiza fasciata*, Gm. (Song Sparrow). (a) Observed to feed on *Thecla humuli*, Harr.: Gentry, *l. c.* i, p. 287.—(b) Observed (with Chipping and Savannah sparrows) to catch and eat a few *Vanessa milberti*, *Pieris*

- rapae* and *Brenthis myrina*: Caroline G. Soule, quoted by Packard, *l. c.* p. 399 (U.S.A.).
23. *Spizella socialis*, Wils. (Chipping Sparrow). (a) Eats *Thecla humuli*, Harr.: Gentry, *l. c.* i, p. 300.—(b) "Chipping Sparrows, in my experience, will chase almost any butterfly and often kill kinds they do not seem to eat." Also recorded (with Savannah and Song Sparrows) as catching and eating a few *Vanessa milberti*, *Pieris rapae* and *Brenthis myrina*: Caroline G. Soule quoted by Packard, *l. c.* pp. 399 and 400 (U.S.A.).
 24. *Passer domesticus*, L. (Sparrow). (a) Observed to capture a *Pieris rapae* on two occasions: L. H. Joutel and Prof. J. B. Smith, quoted by Packard, *l. c.* p. 399 (U.S.A.).—(b) In the investigation carried out in America on the food of the European Sparrow the following notes of attacks on butterflies are recorded: *Papilio turnus*, once; *Vanessa antiopa*, once; Yellow butterfly (? *Colias*), once; Cabbage butterfly, twice; Butterflies (kind not specified), 14 reports: W. B. Barrows, "The English Sparrow, U.S. Dept. Agr., Div. Econ. Ornith.," Bull. i," 1889, p. 102.
 25. *Passerculus*, sp. (Savannah Sparrow). Observed (with Chipping and Song Sparrows) to catch and eat a few *Vanessa milberti*, *Pieris rapae* and *Brenthis myrina*: Caroline G. Soule, quoted by Packard, *l. c.* p. 399.
 26. *Carduelis carduelis*, L. (Goldfinch). "I have seen thistle-finches attack [*Papilio*] *turnus* and [*Argynnis*] *cybele*, but not eat them": Caroline G. Soule, *l. c.* p. 399 (U.S.A.).
 27. *Molothrus pecoris*, Gm. (Cow-bird). Stomachs contained *Colias philodice*: Gentry, *l. c.* i, p. 356.
 28. *Agelaius phoeniceus*, L. (Swamp Blackbird). Stomachs contained Lycaenidae: Gentry, *l. c.* i, p. 360.
 29. *Sturnella magna*, L. (American Meadow Lark). Among other food "*Colias philodice* and many of the Lycaenidae, Tortricidae, are in great demand": Gentry, *l. c.* i, p. 365.
 30. *Icterus spurius*, L. (Orchard Oriole). Stomachs contained Lycaenidae: Gentry, *l. c.* i, p. 371.
 31. *Icterus baltimore*, L. (Baltimore Oriole). Stomachs contained "many of the Lycaenidae and Tortricidae": Gentry, *l. c.* i, p. 377.
 32. *Tyrannus tyrannus*, L. (King-bird). (a) The young

- birds are fed on *Colias philodice* and *Pieris oleracea*: Gentry, *l.c.* ii, p. 33.—(b) Observed to catch *Pieris rapae*: W. Dearden, quoted by Packard, "Proc. Am. Phil. Soc.," 1904, p. 401 (U.S.A.).—(c) "Last summer a pair of King-birds built their nest on a low limb of a tree close to our door. They consumed and fed to their young a great many butterflies, especially the Rape butterfly": Mrs. Mary Treat, quoted by Packard, *l.c.* p. 403.—(d) "Fyles states that he once lost a specimen [of *Oeneis jutta* (Arctic Satyr)] through a King-bird (*Tyrannus tyrannus*) which 'gave chase to the butterfly, and after much doubling and twisting, caught it and disposed of it effectually': S. H. Scudder, "Butt. of E. Un. St. and Canada," i, p. 155.—(e) "On Center Island in the town of Oyster Bay [U.S.A.], in August 1902, I saw a King-bird (*Tyrannus tyrannus*) chase a *Colias*. I stood still and watched it for nearly a minute. It seemed to have great difficulty in getting the insect, and I could hear the beaks snap in the air in their unsuccessful attempts to close upon the insect. The persistence of the bird and the difficulty of the operation of catching the butterfly impressed me very much at the time": Prof. C. B. Davenport (letter dated 8, ii, 1909).—(f) "Summer before last I saw at a distance a bird, I think it was a King-bird but could not make out certainly, chasing one of the Pieridae, either a *Colias* or a *Pieris*, in the valley near the Laboratory [Long Island, New York]. These are all the cases I have in mind, but I have gained the impression that the thing was so common as not to deserve more careful noting": Prof. C. B. Davenport (*ibid.*).
33. *Myiarchus crinitus*, L. (Crested Flycatcher). (a) Butterflies found in the stomach of one specimen: Dr. B. H. Warren, "Birds of Pennsylvania," p. 191.—(b) Observed to eat *Colias philodice*, *Pieris oleracea* and Lycaenidae; from direct observation it was noted that "hosts of Lepidoptera, both larvae and imagoes, are devoured": Gentry, *l.c.* ii, p. 40.
34. *Empidias fuscus*, Gm. (Pewee). (a) The young are fed on *Colias philodice* and Lycaenidae: Gentry, *l.c.* ii, p. 52.—(b) Observed to catch *Pieris rapae*, or a similar species: F. P. Drowne, quoted by Packard, "Pr. Am. Phil. Soc.," 1904, p. 401 (Virginia).—(c) Observed
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to catch a small butterfly: W. Dearden, quoted by Packard, *l. c.* (U.S.A.).

35. *Contopus virens*, L. (Wood Pewee). (*a*) Stomachs contained insects, including butterflies: Dr. B. H. Warren, "Birds of Pennsylv.", p. 194.—(*b*) Observed to eat *Colias philodice*, *Argynnis myrina*, *Grapta interrogationis*, *Chrysophanus americanus*, other Lycaenidae and Satyrinae: Gentry, *l. c.* ii, pp. 64 and 65.
36. *Empidonax acadicus*, Gm. (Small Green-crested Flycatcher). (*a*) Stomachs contained Satyrinae and Lycaenidae: Gentry, *l. c.* ii, p. 67. — (*b*) "Its food consists of insects during spring and summer, such as moths, wild bees, butterflies, and a variety of small kinds": J. J. Audubon, "Ornith. Biogr.," ii, p. 257.
37. *Chordeiles virginianus*, Gm. (Virginian Goatsucker). Stomachs contained *Argynnis aphrodite*, *Pyrameis cardui*, *Chrysophanus americanus*, and many of the Satyrinae and Lycaenidae; the young are fed also on *Pieris oleracea*: Gentry, *l. c.* ii, pp. 95 and 96.
38. *Chaetura pelagica*, L. (Spine-tailed Swift). The young are fed on Lycaenidae, etc.; the old birds also eat *Argynnis aphrodite* and *Pyrameis cardui*: Gentry, *l. c.* ii, pp. 101 and 102.
39. *Coccyzus americanus*, L. (Yellow-billed Cuckoo). (*a*) "They feed on insects such as caterpillars and butterflies, as well as on berries": J. J. Audubon, "Ornith. Biography," i, p. 19.—(*b*) Stomachs contained *Pieris rapae* and Lycaenidae: Gentry, *l. c.* ii, p. 118.
40. *Coccyzus erythrophthalmus*, Wils. (Black-billed Cuckoo). Stomachs contained Lycaenidae: Gentry, *l. c.* ii, p. 114.
41. *Dendrocopos villosus*, L. (Hairy Woodpecker). Stomachs contained Lycaenidae: Gentry, *l. c.* i, p. 130.
42. *Melanarpes erythrocephalus*, L. (Red-headed Woodpecker). Stomachs contained Lycaenidae: Gentry, *l. c.* ii, p. 153.
43. *Falco sparverius*, L. (American Kestrel). (*a*) Stomachs contained "a few of the Papilionidae and Splin-gidae": Gentry, *l. c.* ii, p. 252.—(*b*) A butterfly was found in the stomach of a bird shot at Cataract Creek, Arizona: Dr. A. K. Fisher, "Hawks and Owls of the U. S.," 1893, p. 126 (U. S. Dept. Agr., Div. Econ. Ornith., Bull. iii.).
44. *Falco communis*, Gm. (Peregrine). Stomachs contained Papilionidae: Gentry, *l. c.* ii, p. 242.

45. *Accipiter fuscus*, Gm. (Sharp-shinned Hawk). Stomachs contained "many of the larger Papilionidae and Sphingidae": Gentry, *l. c.* ii, p. 240.
46. *Accipiter cooperi*, Bonap. (Cooper's Hawk). Stomachs contained Papilionidae: Gentry, *l. c.* ii, p. 235.
47. Birds not identified:—
 - (a) "I have on several occasions seen butterflies captured by birds and have seen dragon-flies dart after them": C. V. Riley "3rd Missouri Report," 1871, p. 167.—(b) "Mr. Otto Lugger of Chicago, while on the U. S. Lake Survey, once saw a bird dart after an *archippus* [= *plexippus*] butterfly, seize it and immediately drop it without devouring the body": C. V. Riley, *l. c.* p. 169, note.—(c) "But butterflies are certainly sometimes eaten with us, for several cases are on record where capture has been seen, and I have myself noted one instance where *Euphocades troilus* was unquestionably captured at no great distance from me by a bird. . . . Nearly all the prominent instances that have been mentioned have been taken from the tropics, where I have no doubt the perfect butterflies form a not inconsiderable portion of the food of many birds": S. H. Scudder, "Butterflies of Eastern U. S. and Canada," p. 1612.—(d) "*Turnus* [= *Papilio glaucus*, L.] has many enemies, birds and dragonflies by day, and probably small owls and others by night": Edwards, quoted by Scudder, *l. c.* ii, p. 1303.

NEARCTIC BUTTERFLIES.

DANAINAE.

Anosia plexippus, L.—Bird (47, *b*; butterfly rejected).

SATYRINAE.

Oeneis jutta, Hübn.—*Tyrannus tyrannus* (32, *d*).

Satyrinae.—*Pyrranga rubra* (10, *b*); *Contopus virens* (35, *b*); *Empidonax acadicus* (36, *a*); *Chordeiles virginianus* (37).

NYMPHALINAE.

Argynnis spp.—*Stelgidopteryx serripennis* (16).

A. aphrodite, F.—*Chordeiles virginianus* (37); *Chaetura pelagica* (38).

A. cybele, F.—*Carduelis carduelis* (26).

- Brenthis myrina*, Cram.—Vireo noveboracensis (20);
Melospiza fasciata (22, *b*); *Spizella socialis* (23);
Passerculus sp. (25); *Contopus virens* (35, *b*).
Brenthis bellona, F.—Vireo flavifrons (18).
Polygonia interrogationis, F.—Contopus virens (35, *b*).
Vanessa milberti, Godt.—Melospiza fasciata (22, *b*);
Spizella socialis (23); *Passerculus* sp. (25).
V. antiopa, L.—Geothlypis trichas (10); *Passer domesticus* (24, *b*).
Pyramcis cardui, L.—Chordeiles virginianus (37); *Chaetura pelagica* (38).

LYCAENINAE.

- Heodes hypophleas*, Boisd.—Contopus virens (35, *b*);
Chordeiles virginianus (37).
Thecla melinus, Hübn.—Vireo flavifrons (18); *Melospiza fasciata* (22, *a*); *Spizella socialis* (23).
Lycaeninae.—*Telmatodytes palustris* (6); *Setophaga ruticilla* (8, *a*); *Pyranga rubra* (11); *Hirundo erythrogaster* (12); *Cotile riparia* (15); *Stelgidopteryx serripennis* (16); *Agelaius phoeniceus* (28); *Sturnella magna* (29); *Icterus spurius* (30); *I. baltimore* (31); *Myiarchus crinitus* (33, *b*); *Empidias fuscus* (34, *a*); *Contopus virens* (35, *b*); *Empidonax acadicus* (36, *a*); *Chordeiles virginianus* (37); *Chaetura pelagica* (38); *Coccyzus americanus* (39, *b*); *Coc. erythrophthalmus* (40); *Dendrocopus villosus* (41); *Melanerpes erythrocephalus* (42).

PIERINAE.

- Pieris rapae*, L.—*Turdus mustelinus* (2); *Dendroeca virens* (9); *Tachycineta bicolor* (14); *Melospiza fasciata* (22, *b*); *Spizella socialis* (23); *Passer domesticus* (24, *a*, *b*); *Passerculus* sp. (25); *Tyrannus tyrannus* (32, *b*, *c*); *Empidias fuscus* (34, *b*); *Coccyzus americanus* (39, *b*).
P. brassicae, L.—*Turdus mustelinus* (2).
P. oleracea, Harr.—*Tyrannus tyrannus* (32, *a*); *Myiarchus crinitus* (33, *b*); *Chordeiles virginianus* (37).
Colias sp.—*T. tyrannus* (32, *c*).
C. philodice, Godt.—*Turdus mustelinus* (2); *Myiodioctes pusillus* (7); *Tachycineta bicolor* (14); *Stelgidopteryx serripennis* (16); *Molothrus pecoris* (27); *Sturnella magna* (29); *Tyrannus tyrannus* (32, *a*);

Myiarchus crinitus (33, *b*); *Empidius fuscus* (34, *a*);
Contopus virens (35, *b*).
Terias lisa, Boisd.—*Sialia sialis* (3); *Mimus carolinensis*
(5).
Pierinae.—*Passer domesticus* (24, *b*); *T. tyrannus* (32, *f*).

PAPILIONINAE.

Papilio glaucus, L.—*Passer domesticus* (24, *b*); *Carduelis carduelis* (26); Birds (47, *d*).
P. troilus, L.—Bird (47, *c*).
Papilioninae.—*Falco sparverius* (43); *Falco communis* (44); *Accipiter fuscus* (45); *Accipiter cooperi* (46).

HESPERIIDAE.

Epgaryreus tityrus, F.—*Vireo noveboracensis* (20).

RECORDS FROM THE NEOTROPICAL REGION.

- Vireo olivaceus*, L. (Red-eyed Vireo). "I have seen one in eager, but unsuccessful pursuit of a butterfly (*Terias*)": P. H. Gosse, "Birds of Jamaica," p. 194.
- Muscivora regia*, Gm. "Feeds principally, and perhaps exclusively, upon butterflies. . . . M. Jelski's opinion, that the crest of these birds [which is said to resemble a flower—G. A. K. M.] serves as a lure for butterflies, appears to me to be correct": Stolzmann, quoted by Taczanowski, "Ornithologie du Pérou," ii, p. 296.
- Pachyrhamphus versicolor*, Hartl. "In their stomachs I have found butterflies, larvae and rather hard bugs": Jelski, quoted by Taczanowski, *l. c.* p. 367 (1884).
- Galbula* sp. (Jacamar). (*a*) "It feeds entirely on insects . . . and as soon as a fly, butterfly or moth passes by, it darts at it and returns to the branch it had just left": C. Waterton, "Wanderings in S. America," p. 123 (1839).—(*b*) "Pöppig states in regard to the closely-related Galbulidae 'that in the forests there is no difficulty in recognising the favourite perch of a *Galbula*, for the wings of the largest and most splendid butterflies, whose bodies alone are eaten, cover the ground for some steps around': E. Haase, "Researches on Mimicry" (transl.), ii, p. 101.
- Brachygalba melanosterna*, ScL (Black-chested Jacamar). Natterer records that in Brazil this bird sits on the twigs of the highest trees and hunts for butterflies: Von Pelzeln, "Sitzb. K. Akad. Wiss. Wien," xx, 1856, p. 518.

Malacoptila fusca, Gm. (White-breasted Softwing). "The Prince von Wied found in the stomach of *Monastes fusca*, a Bucconid, 'a large butterfly which crumpled up together filled almost the whole stomach': E. Haase, *l.c.* p. 101.

Nyctibius aethereus, Wied. "These wide-mouthed birds are a particular enemy of various large and beautiful Lepidoptera, as I have been able to fully satisfy myself. They consume these insects in quantities, and the traces of their meals may be found in the large rejected wings which lie about in numbers on the ground in the Brazilian forests . . . Thus may be found the largest and most beautiful of the Brazilian Lepidoptera, [*Morpho*] *menelaus*, [*Caligo*] *idemencus*, *Phalaena agrippina* [*Noctua strix*, L.], and many others": Max. Prinz zu Wied, "Beitr. z. Naturgesch. von Brasilien," iii (1), p. 309, (1830).

Sandpiper. The butterflies which often collect in large numbers in damp places were not observed to be attacked by insectivorous birds "except certainly by the Sandpipers (Strandläufern), which, like the lizards, are never particular": P. Hahnel, "Iris," 1890, p. 317 (Amazons).

Birds not identified:—

- (a) "I observed a pair of birds that were bringing butterflies and dragonflies to their young, and although the *Heliconii* swarmed in the neighbourhood and are of weak flight so as to be easily caught, the birds never brought one to their nest": T. Belt, "Naturalist in Nicaragua," p. 316.—(b) Of a Brazilian bird called "Suruquá," the author states that "its principal food consists of butterflies and other soft-bodied insects": T. P. Bigg-Wither, "Pioneering in S. Brazil," i, p. 292.—(c) "No other group of butterflies is so much sought after by birds as the Pieridae, and these freebooters have often snatched away from me at my very side the most beautiful and perfect specimens. The unerring accuracy of their flight filled me with wonder on every occasion, and I was glad to pay for the exhibition by the loss of a specimen. Once, however, I was even more astonished, when I witnessed the lucky escape of a hunted butterfly. On this occasion it was no Pierid, but a great *Caligo*, which I had aroused and which one of these highwaymen

pursued forthwith. With incredible agility this huge insect managed to evade all the attacks of the closely pursuing bird, escaping out of one bush into another. It was an even race, which I watched with the deepest interest, until at last the hunted creature saved itself in a thicket of tangled branches and the wearied bird desisted from further pursuit": Paul Hahnel, "Iris," 1890, p. 193 (Venezuela).

RECORDS FROM THE AUSTRALIAN REGION.

Sisura inquieta, Lath. (Restless Flycatcher). "The food of this species consists chiefly of insects of various kinds, principally flies, small moths and butterflies, captured more frequently while on the wing": A. J. North, "Nests and Eggs of Birds of Australia," p. 136.

Microcca fascians, Lath. (Brown Flycatcher). "Its food consists principally of flies, small moths and butterflies, captured while on the wing": A. J. North, *op. cit.*, p. 150.

Petrocca leygei, Shafer (Scarlet-breasted Robin). "Its food consists of insects, principally small moths, butterflies, beetles, etc.": A. J. North, *op. cit.*, p. 164.

The paucity of records from the Neotropical Region is very striking and much to be deplored, for such information as we have seems to indicate that the destruction of butterflies by birds must occur there on a considerable scale. It is curious that not one of those excellent observers, Wallace, Bates, Fritz Müller or Belt, has given us a single record of attack in which either bird or butterfly was identified. Possibly they may have considered, like some other naturalists whom I have consulted, that the phenomenon was of such frequent occurrence as not to require special noting. It is to be hoped that the publication of this paper may do a little towards dispelling that idea. We want heaps more evidence before we can arrive at any sound conclusions as to the exact relations which exist between butterflies and their bird enemies. The publication of isolated cases is of little value; the evidence to carry weight must be in bulk. I propose to continue collecting it, and shall be very grateful to any correspondents who may be kind enough to assist me with any further records. Communications may be addressed to 6 Chester Place, Hyde Park Square, London, W.

XIV. *An Account of some Experiments on the Edibility of certain Lepidopterous Larvae.* By H. ELTRINGHAM, M.A., F.Z.S.

[Read October 6th, 1909.]

FOR a considerable period, following on the first enunciation of the theories of Batesian and Müllerian mimicry and common warning colours, the criticism that these theories were based on small practical evidence was to some extent justified. Such criticism, however, did not in any way invalidate the theories in question. It had also the highly salutary effect of acting as a stimulus, not only to the upholders but also to the opponents of these theories, to carry out practical experiments with a view to obtaining actual evidence bearing on some of the points involved.

It is a matter of common knowledge amongst those who have studied these subjects, that the experiments which have been recorded all tend to support the now well-known theories of mimicry which had their origin in the celebrated arguments published nearly fifty years ago by Mr. H. W. Bates. Amongst the many points to be elucidated, one of the most important was the proof of the comparative inedibility of many insects. For much valuable evidence on this head we are indebted to the experiments of Mr. Jenner Weir, Mr. A. G. Butler, Prof. Weismann, Mr. F. Finn, and especially to those of Prof. Poulton and Mr. G. A. K. Marshall, and it can no longer be said with justice that the hypothesis of the comparative distastefulness of most warningly coloured insects rests on insufficient evidence.

Arising out of the foregoing experiments, one of the results obtained by Prof. Poulton* was as interesting as it was unexpected. Whilst in accordance with anticipation, warningly coloured larvae were found to be distasteful, and cryptic larvae edible, one instance was discovered in which a larva (that of *Mania typica*), though exceedingly

* Proc. Zool. Soc. 1887, Experimental Proof of the Value of Colour and Markings in Insects in Reference to their Vertebrate Enemies.

well protected by its colour and habits, proved to be distasteful to the lizards which were being used for the purpose of the experiments. The importance of this result is fully discussed by the author,* who points out that we have here an instance in which the distasteful qualities are present as an accidental and useless character, but providing an excellent example of how the distasteful properties of many forms may have existed prior to the development of warning colours, conditions being thus favourable to the development of the latter in the event of any change being brought about in the larval habits.

It was in the hope of perhaps discovering another case of a similar character, that I decided to carry out some experiments with the only insectivorous creatures which were available, viz. lizards, and with such larvae as I was able to obtain.

Two green lizards (probably *Lacerta viridis*) were installed in a fairly large vivarium, and their number was subsequently increased by the addition of three more of the same small variety, and two fine examples of the larger Channel Islands form. There were also two orange and black salamanders, but these proved to have such poor appetites that they provided very little information.

The general results of feeding the lizards with various insects confirmed those already obtained by other observers, though there were some unimportant exceptions. The larva of *Pieris brassicae* is recorded by Prof. Weismann as having been refused by his lizards. I found that on some occasions it was eaten, though with considerable hesitation and usually when the animal was hungry. One of the salamanders refused it after examining it carefully for some time. Earthworms were eaten with avidity, and "blue-bottles" (*Calliphora vomitoria*) were always taken with evident relish. The larva of *Spilosoma lubricipeda* was generally refused, though the lizards took considerable interest in it. One lizard followed the larva round the cage for some time, feeling it with its tongue, but the hairs always put it off, and it was finally abandoned. A young larva not so hairy was eaten on one occasion after some trouble with the hairs, a fact which seems to suggest that the protection is mechanical and not due to actual distastefulness. A "devil's coach-horse" (*Ocyrops olens*) was eaten, though the operation took a considerable time,

* *L. c.*, p. 241, *et seq.*

and once the beetle appeared to nip the lizard with its mandibles, as it dropped it suddenly and went through surprising contortions.

The imago of *P. rapae* was eaten with apparent relish, as also that of *Plusia gamma*. Green and greenish-brown larvae of cryptic habits were eaten, as also were the extremely cryptic geometrid larvae of *Amphidasys betularia* and *Selenia lunaria*. A bee was attacked and dropped, though the salamanders ate bees with impunity. The most interesting results were obtained with the larvae of *Boarmia rhomboidaria*. This larva was found in large numbers feeding on ivy. Probably few British larvae have attained to a more perfect development of cryptic form, colour and habit than this species. It resembles so perfectly the twigs of the ivy that it is frequently only possible to detect it by the sense of touch. If thrown down it will often lie perfectly straight and motionless, when it is practically indistinguishable from a small piece of stick. According to the general rule it would be expected that this larva when detected would prove to be as palatable as *betularia*, *lunaria*, and other similar forms. My experiments, however, proved that quite the opposite is the case. I was interested to discover whether this unpalatability could be traced to any definite secretion, such as potassium hydroxide. A crushed larva gave a slight alkaline reaction with litmus paper, so I boiled a considerable number of the larvae and tested the filtered solution. The alkalinity was, however, so slight that it seemed unnecessary to pursue the examination in this direction, and it appeared probable that the food-plant might be directly responsible for the chemical reaction. This again proved not to be the case, as the crushed shoots of ivy were found to be slightly acid.

As the larva in question will eat other plants than ivy it occurred to me to try the effect of a change of food-plant on its edible properties. I found that after being fed on apple for from two to three days and onwards, the distasteful properties disappeared and the apple-fed larvae were eaten without any hesitation.

I herewith append notes from my journal made at the time of each experiment, in order that those interested may judge of the results for themselves.

August 29.—A salamander ate an earthworm, then a bee (without apparently being stung), and then another

worm. It then very carefully inspected a larva of *P. brassicae*, started backwards slightly, and finally refused to look at it.

One lizard ate a small worm, then part of a larger one; it then examined a larva of *brassicae* and seized it, holding it in its mouth by a very small grip of the skin for about three minutes, then it bit it harder and put it out. Then it picked it up very doubtfully and swallowed it very slowly. The other lizard, which had had nothing for at least two days, seized the same kind of larva and swallowed it, apparently without compunction; it then rubbed its nose against the glass of the cage for some time, and once appeared to writhe on the floor. Later on it was offered another of the same larvae, but it would have nothing to do with it. It then turned round and bit the other lizard twice, though the object of this manœuvre was not apparent.

August 30.—One of the lizards tried to eat a larva of *rhomboidaria*, but left it after two attempts.

August 31.—A lizard after some hesitation appeared to swallow one of these larvae, but a moment later vomited it up again, ran violently round the cage, and then drank some water. A few hours later it bit another, but put it out and rubbed its nose on the pebbles.

September 1.—The other lizard behaved in exactly the same way this morning. The first lizard was given a larva of *Spilosoma lubricipeda*. It followed it all round the cage feeling it with its tongue, but though it evidently wanted to try it the hairs put it off, and it finally abandoned it. After this neither lizard would eat anything.

September 2.—One lizard examined a larva of *S. lubricipeda*, but the hairs put it off. Then each lizard ate a worm, and one subsequently ate a larva of *P. brassicae* rather slowly, putting it out once but finally swallowing it. Later in the day one lizard attacked a "devil's coach-horse" (*Ocyrops olens*). It took about half-an-hour to eat it, continually dropping it and picking it up again. Once it dropped it suddenly and went through the most violent contortions, rubbing its head sideways and half burying itself under the gravel. Whatever the cause of this may have been, it again picked up the beetle and began to swallow it; apparently it had the greatest difficulty in doing so, as it shook it out of its mouth several times. Ultimately, however, it got it down.

September 3.—One lizard ate three blue-bottles and a *P. rapae*. The other one ate a green caterpillar (probably *Hadena oleracea*). Neither would touch a larva of *rhomboidaria*. Later on the first lizard ate another *P. rapae*, and the second ate two brownish-green larvae taken off chrysanthemum plants.

September 5.—Lizards had nothing to eat yesterday. This morning one of them ate a blue-bottle, and I then offered it a larva of *rhomboidaria*. It seized it by the tail and held it in its mouth for a short time, then worried it furiously. As soon as it got a little more into its mouth it dropped it and began rubbing its mouth violently on the floor of the cage. Afterwards it would not look at it again. The larva was still alive and the other lizard came and looked at it, but either smelt it or recognized its appearance, as it would not bite it. The first lizard immediately afterwards ate a "blue-bottle," and about two hours later a small earthworm. The manner in which it swallowed these was very different to that in which it treated the caterpillar. There was no hesitation, and the worm was gulped down very rapidly.

(Note.—These lizards ate larvae of *P. brassicae* but slowly, and as though not greatly appreciating them.)

Later in the day one lizard ate four "blue-bottles" and a *P. rapae*. The salamander ate three bees. The lizard snapped up a bee but dropped it again suddenly, as though stung, and would not look at another.

September 7.—Lizard ate two "blue-bottles," a brownish-green larva from the chrysanthemums, and a "gamma" moth.

The other lizard ate a larva of *rhomboidaria* which had been fed on apple for two days. While it was eating it the other lizard chased it round and round the cage. A second apple-fed larva was refused by both lizards. Later on one lizard ate a worm but tasted and refused a wood-louse.

September 8.—First lizard would not look at an apple-fed *rhomboidaria* larva, but the other one ate it, rather slowly at first. An ivy-fed one was then offered, but neither lizard would touch it. The first lizard then ate two "blue-bottles."

September 9.—Five more lizards arrived.

One of the original pair ate an ivy-fed caterpillar with some hesitation, afterwards drinking water. One of the

new lizards, presumably hungry, was given an ivy-fed larva of *rhomboidaria*, it bit it and then dropped it, going through violent contortions and rubbing its nose on the pebbles. A little while later it was given a larva which had been fed on apple for four days. It ate it without any hesitation. It was then offered the ivy-fed larva which it had before refused, and after some hesitation it swallowed it, though evidently without any keenness. Another of the new lizards was then offered an ivy-fed larva. It bit it and dropped it suddenly, rubbing its nose on the pebbles. It then took another bite and put it out again, opening its jaws wide and then rubbing its nose on the floor. After a while it was induced to try an apple-fed example, which it swallowed rapidly after a short hesitation. The ivy-fed larva previously refused was then again offered, but it would not touch it.

One of the original lizards ate a larva of *betularia* and one of *lunaria*, but smelt and refused an ivy-fed *rhomboidaria*.

September 10.—A large lizard ate an ivy-fed larva with considerable hesitation, putting it out four times. This lizard had had nothing to eat for some days. After this it ate another ivy-fed larva with rather less hesitation. A third was seized by it and another lizard. They fought over it furiously, and the caterpillar was pulled in two and each swallowed its own piece. The competition apparently had something to do with the result, as immediately after the second lizard bit another larva and dropped it, rubbing its nose violently. A third lizard came up and examined the larva, when the other seized it again but dropped it like a hot coal. Another lizard twice examined and refused one of these larvae.

September 11.—A lizard ate rapidly and without hesitation two larvae of *betularia* and a "green-bottle." An ivy-fed *rhomboidaria* was then offered, but it examined it carefully and refused to touch it.

September 12.—An ivy-fed larva was offered to one of the lizards. It seized it at once and nearly managed to swallow it, but suddenly ejected it and rubbed its nose violently on the pebbles. After this it would not even eat a "blue-bottle," and an apple-fed *rhomboidaria* was disregarded. One of the large lizards was given a *rhomboidaria* larva which had been fed on apple for about a week. It seized it and ate it at once. It was then

given another taken from the ivy. It seized it at once and gave it two bites, dropped it and rubbed its nose on the pebbles. The original two lizards were offered ivy-fed caterpillars, but after inspection they would not touch them. They appear to have learnt that they are not good to eat. Another lizard seized an ivy-fed larva, but after two bites dropped it and rubbed its nose. It subsequently ate a "blue-bottle." Another lizard ate a young larva of *lubricipeda*, though the hairs bothered it a good deal at first, the lizard being apparently either pricked or tickled. An older and more hairy larva was examined, but refused on account of the hairs. Greenish larvae (probably *Hadena oleracea*) were eaten without hesitation.

September 13.—During a short sunny interval one of the large lizards came out and tasted an ivy-fed larva, but dropped it after two bites and rubbed its nose. It would not eat anything else after this.

Soon after the last-named date I was called abroad for a time, and was therefore unable to continue the experiments. Nevertheless it appears to me that extremely interesting conclusions may reasonably be drawn therefrom. It should be remembered that the mere bald statement that a lizard did or did not eat a certain insect scarcely supplies that conviction which the actual carrying out of the experiments conveys. The behaviour of the reptiles when dealing with their food gives a vivid impression of the degree of relish with which each particular morsel is consumed, and I am quite convinced by carefully watching the lizards that ivy-fed larvae of *Boarmia rhomboidaria* are extremely distasteful, and I am equally persuaded that when fed for a time on apple those distasteful qualities are removed. Ivy-fed larvae were tasted and refused with disgust seventeen times, and eaten five times. Even on the mere figures the evidence of distastefulness is ample, but in the cases where the larva was eaten, it was consumed with hesitation and evident lack of relish, whilst once it was eaten under stress of competition, the influence of which is hinted at by the example of the lizard which had tasted and refused the larva making a second attempt to eat it when threatened with interference by another of the reptiles. In strong contrast to this behaviour is the fact that apple-fed larvae were eaten in every case in which they were tasted, such hesitation as was shown being due to association with the

appearance of the previously discarded ivy-fed example whilst an apple-fed specimen was in no case rejected and again seized, but always swallowed uninterruptedly and without any of the characteristic nose-rubbing and other contortions which accompanied the dealings with those fed on ivy. From these facts it seems quite reasonable to conclude that when feeding on apple this highly cryptic larva remains as edible as are most other insects which are well protected by their colour, shape, and habits. The caterpillar is even better protected on ivy owing to the density of the foliage and the irregularity of the twigs, and yet when on that plant it becomes extremely distasteful, and furnishes an exactly similar case to that of *Mania typica*, discovered and described by Prof. Poulton. We thus have further evidence that the distasteful qualities of larvae may have arisen in similar accidental ways, and the difficulty of those "first steps" in evolutionary changes are still further decreased. We can see how a cryptic larva which occurs on a certain food-plant might be sought out and discovered by its enemies, and if the latter were sufficiently numerous and persistent, the insect might be exterminated. If, however, the larva can adapt itself to a change of food, it may gain some respite until again discovered. This may bring about a great change in the creature's method of defence. Its new food-plant endows it with inedible properties, and thus the insect has a further opportunity of developing a new mode of protection along different lines. To extend such reasoning, it seems not impossible that a purely Batesian mimic might become a Müllerian mimic by the same method. Batesian mimics are much associated with their models during life, and the instinct which guides a butterfly to lay its eggs on the right food-plant is not invariably infallible. Thus ova of an inedible species deposited on a new food-plant might conceivably give rise to larvae which survived and produced distasteful butterflies; and whilst the fact of such an occurrence may remain unproved, its evident possibility should serve to remind us once more of the complicated conditions under which butterflies in common with other creatures maintain their existence in the struggle for life.

(Note.—I am indebted to my friend, Commander J. J. Walker, for kindly identifying the Geometrid larvae above described.)

IV. *Studies of the Blattidae.* By R. SHELFORD, M.A.,
F.L.S.

[Read February 3rd, 1909.]

PLATES VII—IX.

X. A REVISION OF THE OLD-WORLD BLATTINAE BELONG-
ING TO THE *POLYZOSTERIA* GROUP.

A STUDY of the collection of Blattidae recently made in West Australia by Drs. Michaelsen and Hartmeyer soon convinced me that a thorough revision of the Australian Blattinae was an urgent necessity. Tepper has described numbers of species in the Transactions of the Royal Society of South Australia, but the identification of his species has always been attended with considerable difficulty since this worker's views on classification are rather peculiar and his descriptions are not supplemented with figures. Kirby, in his Synonymic Catalogue of Orthoptera vol. i, has made a laudable endeavour to reduce the Tepperian species and genera into something like order, but as he had neither time nor opportunity to consult any types but those of Walker, he has not succeeded in decreasing the confusion. Guessing at the generic identity of species involves all sorts of risks, and consequently Mr. Kirby's emendation of Tepper's genera has resulted in several serious errors. To take one example:—he sinks *Temnelytra*, Tepp., as a synonym of *Zonioploca*, Stål, though the two genera are totally distinct, and includes in the revised genus species belonging to no less than five genera. The straightening-out of the terrible tangle into which this group of cockroaches had been twisted has been attended with very great difficulty, for I have been unable to borrow types from the South Australian Museum and Mr. Tepper has not responded to appeals for the comparison with his types of specimens sent to him from the Hope collection. Fortunately Professor Baldwin Spencer and Mr. W. W. Froggatt most kindly came to the rescue; the former has sent me all the Tepperian types in the Melbourne Museum, and the latter has presented or lent to the Hope Museum specimens determined by Mr. Tepper himself. With these valuable aids, for which I cannot be too grateful, I have been able to determine

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with accuracy the great majority of genera and species described by Mr. Tepper; in addition the types of Walker in the British Museum have been examined. Dr. Th. Kuhlitz, late of the Berlin Museum, has sent me drawings of Erichson's types and has compared specimens sent to him. Dr. K. Holdhaus of Vienna has lent me some of Brunner's types and Dr. Y. Sjöstedt of Stockholm all the types of Stål. I trust that the net result of the considerable correspondence and hard work expended on this memoir is a satisfactory classification which will bear the test of time and enable other workers to identify the species of the group without great difficulty.

The Blattinae can be divided into two chief sections according to the structure of the posterior tarsi; the first section, which may be styled the *Polyzosteria*-group, has the posterior metatarsus usually shorter than the succeeding joints and usually unarmed beneath,* the succeeding joints are entirely unarmed and with large pulvilli; the second section or *Blatta*-group has the posterior metatarsus longer than the succeeding joints and armed beneath, the second and third joints are also armed and their pulvilli are apical (Pl. III, f. 40). A revision of the second section I hope to undertake on some future occasion. The *Polyzosteria*-group can be subdivided into an Old-World group and a New-World group, but the character on which this subdivision is based—the relative distances apart of the eyes and the antennal sockets—is so subtle that I doubt its practical importance and I temporarily regard the New-World group as distinct from the Old-World group for convenience sake only. In the Old World, Australia is undoubtedly the head-quarters of the *Polyzosteria*-group, nearly all the apterous species are confined to that continent and the islands immediately surrounding it; but one or two, and notably *Cutilia nitida*, Br., have a much wider range, extending into the Oriental region and Polynesian islands. The occurrence of an allied species at Bombay is very singular and an error in locality is suggested. As might be expected the winged species (genus *Methana*) have a wider range than is characteristic of the wingless forms, but even these do not extend to the Asiatic mainland. The group in Africa is represented by the single monotypic genus *Paramethana*. The geographical distribution of these cockroaches would appear to

* *Cutilia* is an exception.

favour the view that they constitute a somewhat primitive group, for Australia is universally regarded as the last refuge of animal forms that have disappeared from the less isolated quarters of the globe. But I do not think that the Blattinae as a whole can be considered as other than the most highly evolved group of cockroaches, since the structure of the genital valves in the female sex is certainly a peculiar modification and not a primitive character, whilst the male genitalia are more complex than in many other subfamilies. Whether the *Blatta*-group is more primitive than the *Polyzosteria*-group, is open to argument, but I am inclined to think that it is not.

Structurally the *Polyzosteriae* offer valuable diagnostic characters, especially in the male sex, so that the separation of the species is not attended with the difficulties that confront one when dealing with such homogeneous genera as *Epilampra*, *Blabera*, *Gyna*, etc.; but the allocation of the females of some genera to their respective males is not easy and the descriptions of new species from females alone ought to be avoided in future.

Bionomically these insects are very interesting: some are brightly coloured, e.g. *Euzosteria mitchellii*, and the shining black species of *Platyzosteria* must also be very conspicuous. Many of the species have a disgusting odour, and one species of *Cosmozosteria* identified by Mr. J. J. Walker as *C. lateralis* extrudes from the apex of the abdomen when irritated a red vesicle and emits an odour so pungent that Mr. Walker was deterred from capturing specimens. Mr. Froggatt tells me that all the species expose themselves freely and are frequently found basking on the tops of fence-posts. The egg-capsules of a few species are known, and are typically Blattine in form.

KEY TO GENERA.

1. Ocelli usually absent. Tegminal rudiments absent. Abdominal tergites with well-marked stigmatic dots. Supra-anal lamina (♀) more or less bilobate. Cerci blunt and flattened, generally not extending beyond the supra-anal lamina.
2. Tibial spines in two rows *Polyzosteria*, Burm.
- 2'. Tibial spines in three rows *Euzosteria*, nov.

- 1'. Ocelli present. Tegmina present, rudimentary or absent. Abdominal tergites rarely with stigmatic dots. Supra-anal lamina (♀) not bilobate. Cerci longer, apex usually acuminate.
2. Wings absent or rudimentary. Tegmina rudimentary or absent.
3. Tegmina absent or represented by squamiform lobes.
4. Posterior angles of the 5th and 6th abdominal tergites backwardly produced.*
5. Posterior metatarsus short, not spined beneath or with only a few spines; its pulvillus usually large, and occupying at least half of the joint.
6. Lateral margins of pronotum not incrassated. Thoracic tergites more or less smooth and nitid.
7. Supra-anal lamina (♂) not produced to form an acute spine *Platyzoisteria*, Br.
- 7'. Supra-anal lamina (♂) produced to form an acute spine *Leptozoisteria*, Tepp.
- 6'. Lateral margins of pronotum incrassated. Thoracic tergites punctate or tuberculate *Zonioploca*, Stål.
- 5'. Posterior metatarsus longer, spined beneath, its pulvillus not occupying one half of the joint *Cutilia*, Stål.
- 4'. Posterior angles of the 5th and 6th abdominal tergites not backwardly produced, or if produced the abdominal tergites are scabrous. Tegmina entirely absent.

* *Cutilia sedilloti*, Bol. (♂), is an exception.

5. Posterior angles of 7th abdominal tergite backwardly produced; abdomen above scabrous. *Cosmozosteria*, Stål.
- 5'. Posterior angles of 7th abdominal tergite not backwardly produced; abdomen above smooth, nitid.
6. Lateral margins of pronotum not incrassated. *Anamesia*, Tepp.
- 6'. Lateral margins of pronotum incrassated. *Desmozosteria*, Shelf.
- 3'. Tegmina quadrate, as long as the pronotum.
4. Wings absent *Temnelytra*, Tepp.
- 4'. Wings rudimentary *Scabina*, nov.
- 2'. Tegmina and wings well developed.
3. Pronotum anteriorly parabolic, sides deflexed *Methana*, Stål.
- 3'. Pronotum discoidal, sides not deflexed *Paramethana*, Shelf.

Genus 1. POLYZOSTERIA, Burm.

Polyzosteria, Burmeister, Handb. Ent. ii, p. 482 (1838);
 Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 203 (1865).

Chalcolampra, Saussure, Mém. Soc. Sc. Phys. Nat.,
 Genève, xvii, p. 132 (1863) (preoccupied in Coleoptera).

Characters. Ocelli absent. Antennae shorter than the body. Pronotum anteriorly somewhat cucullate, margins not reflected, posteriorly truncate. Tegmina and wings entirely absent. Posterior angles of the 7th abdominal tergite strongly produced backwards, angles of the preceding tergites not, or scarcely, produced, angles of the 9th tergite sometimes lobiform (cf. fig. 1). Stigmatic dots on abdominal tergites well-marked. Supra-anal lamina, (♂) quadrate, angles acute, (♀) sub-bilobate, cucullate. Sub-genital lamina (♂) sub-quadrate, styles short, obtuse. Cerci short, flattened, blunt at apex. Tibiae robust, almost quadrangular in section, spines on outer aspect in 2 rows. Posterior metatarsus very short, unarmed beneath, its pulvillus occupying the greater part of the joint.

KEY TO THE 'SPECIES.

1. Dorsal surface margined or spotted with
 ochreous yellow.

- 2. Legs aeneous.
- 3. Body above without tubercles.
 - 4. Pronotum with 2-4 deep punctures on the disc *P. limbata*, Burm.
 - 4'. Pronotum without these punctures *P. iridicolor*, Tepp.
 - 3'. Body above with tubercles *P. bagoti*, Tepp.
- 2'. Legs testaceous or castaneous.
- 3. Pronotum not tuberculate.
 - 4. Posterior margin of pronotum not ochreous-yellow *P. cuprea*, Sauss.
 - 4'. Posterior margin of pronotum ochreous-yellow *P. impressa*, Tepp.
 - 3'. Pronotum tuberculate *P. obscuriviridis*, Tepp.
- 1'. Dorsal surface unicolorous (except for margins of supra-anal lamina and cerci).
- 2. Large species with dense sericeous pile. *P. pubescens*, Tepp.
- 2'. Smaller species, sericeous pile absent or very sparse.
 - 3. Dorsal surface tuberculate *P. oculata*, Tepp.
 - 3'. Dorsal surface not tuberculate.
 - 4. Colour dull bronze *P. invisa*, Walk.
 - 4'. Colour metallic green *P. viridissima*, sp. n.

The above key must be regarded as merely provisional, for I have not been able to see all the species described by Tepp, and from the descriptions alone of these it is not possible to determine their generic position with exactitude.

1. *P. limbata*, Burm.

Polyzosteria limbata, Burmeister, Handb. Ent., ii, p. 483 (1838).

Polyzosteria acnea, Burmeister, t. c., p. 483 (1838).

Polyzosteria purpurascens, Fischer, Orth. Eur., p. 93 (1853).

Polyzosteria pulchella, Saussure, Rev. Zool. (2), xvi, p. 308 (1864).

Polyzosteria nitens, Walker, Cat. Blatt. Brit. Mus., p. 155 (1868).

? *Polyzosteria frenchii*, Tepp, Tr. R. Soc. S. Australia, xviii, p. 178 (1894).

The species is well known and does not require re-description. It is very variable, as can be guessed from

the synonymy. A study of a long series convinces me that *acnea* is merely a colour variety of *limbata*; in typical *limbata* the colour is blackish and the yellow lateral margins of the pronotum are broad, whereas in typical *acnea* the colour is greenish-bronze and the pronotum is very narrowly flavo-marginate, but I have seen several intermediate specimens. The two examples of *P. nitens* in the British Museum look as if they had been varnished, but they show no characters whereby they can be separated from typical *limbata*. The only specimen of *P. frenchii* that I have seen is in the Melbourne Museum, it was determined by Mr. Tepper himself and is certainly the same as *P. limbata*. I have not seen the type.

NEW SOUTH WALES; VICTORIA; SOUTH and WEST AUSTRALIA; TASMANIA.

2. *P. iridicolor*, Tepp.

Polyzosteria iridicolor, Tepper, Tr. R. Soc. S. Australia, xvii, p. 73 (1893).

Known to me only by the description.

SOUTH AUSTRALIA, Gawler range. (Adelaide Mus., type.)

3. *P. bagoti*, Tepp.

Polyzosteria bagoti, Tepper, t.c., p. 79 (1893).

Known to me only by the description. It appears to be distinguished by the dorsal surface furnished with "irregular low tubercles." As it is only 14-16.5 mm. in length, it is probably the larva of some previously described species.

SOUTH AUSTRALIA, Port Augusta. (Adelaide Mus., type.)

4. *P. cuprea*, Sauss.

Polyzosteria cuprea, Saussure, Mém. Soc. Sc. Phys. Nat. Genève, xvii, p. 133, Pl. I, f. 2 (1864).

Polyzosteria maculata, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 206 (1865).

A well-known species.

SOUTH and WEST AUSTRALIA.

5. *P. impressa*, Tepp.

Polyzosteria impressa, Tepp. [in] Horn Exped. Centr. Australia, ii, p. 361 (1896).

Known to me only from the description which I reproduce herewith.

"♀. Metallic blackish glaucous; fore- and hind-margin of pronotum and the hind-margins of all the other segments narrowly yellow. Face, antennae, legs (except ochreous coxae) and ventral segments of abdomen, brownish-red. Vertex of head dull metallic green, punctate; fore margin of clypeus whitish. Pronotum hooded, lateral margin broad, reflexed, impressed cribriform, rugulose, hind-angles moderately rounded; discal area limited by a semicircular interrupted impression, in front a low elevation succeeded by an inversely curved depression, and on each side of the middle an elongated pit; hind-margin concave. Meso- and meta-notum with similar sculpture and transverse impressions; hind-angles of former distinctly produced, hind-margin straight; of latter, hind-angles not produced, hind-margin very sinuous. Abdomen short, very slightly rugulose, margin of last two segments finely crenulate and hind-angles produced; 1st ventral segment and coxae bordered pale. Supra-anal lamina very flat and short, rotundate, entire, rugulose. Cerci very short, acuminate, pale yellow.

Total length 28 mm.; pronotum 8 mm. × 18 mm."

CENTRAL AUSTRALIA.

6. *P. obscuroviridis*, Tepp.

Polyzosteria obscuroviridis, Tepp., Tr. R. Soc. S. Australia, xvii, p. 73 (1893).

Unknown to me; it is distinguished by the pronotum, "studded with irregular rows of large raised tubercles" and by the bicolorous legs.

SOUTH AUSTRALIA, Gawler range. (Adelaide Mus., type.)

7. *P. pubescens*, Tepp. (Plate VII, fig. 1).

Polyzosteria pubescens, Tepp., t. c., p. 75 (1893); Froggatt, Australian Insects, p. 19, fig. 6 (1907).

Fuscous, with a greenish tinge, all the tergites very narrowly bordered posteriorly with testaceous. Dorsal surface with a dense

grey sericeous pile more or less worn along the middle line. Body subtectiform. Dorsal surface scabrous. Frons concave and rugosely punctate. Antennae ochreous. Pronotum anteriorly cucullate, anterior margin sub-sinuate. Body beneath ochreous outwardly margined with castaneous, apex of the abdomen castaneous. Cerci ochreous. Supra-anal lamina, (♂) sub-quadrate, (♀) produced, cucullate, apex emarginate. 9th abdominal tergite backwardly produced at its outer angles to form two blunt processes, outwardly margined with ochreous. Coxae testaceous with a castaneous stripe, femora, tibiae and tarsi castaneous with a metallic tinge. Femora beneath and tibial spines testaceous. Femoral spines very small.

Length (♂) 30-34 mm., (♀) 40-44 mm.; pronotum 10-11.5 mm. × 20-25 mm.

WEST AUSTRALIA (Oxford Mus.; Hamburg Mus.; Melbourne Mus.; Adelaide Mus., type).

8. *P. oculata*, Tepp.

Polyprosteria (sic) *oculata*, Tepper, t. c., p. 75 (1893).

Dull bronze above with irregular rows of flattened tubercles. Stigmatic dots very prominent. Laterally with faint indications of a sericeous pile. Cerci and supra-anal lamina edged with ochreous. Head rugose, frons not concave. Antennae castaneous at base, remainder fuscous. Underside of thoracic tergites orange. Abdomen beneath castaneous with metallic sheen, the underside of the lateral margins of the 7th abdominal tergite brilliant metallic green. Supra-anal lamina, (♂) quadrate, posteriorly widely emarginate, (♀) produced, broad, deeply emarginate. Sub-genital lamina (♂) sub-quadrate; styles stout, incurved, their apices acuminate. Posterior angles of 7th abdominal tergite very strongly produced backwards, angles of 9th tergite as in *P. pubescens*. Coxae margined with ochreous; femora castaneous, tibiae dark metallic green, spines ochreous tipped with rufous.

Length (♂ and ♀) 31 mm.; pronotum 9.3 mm. × 19 mm.

SOUTH AUSTRALIA; VICTORIA (Oxford Mus.; Melbourne Mus., ♂ type; Adelaide Mus., ♀ type).

9. *P. invis*a, Walk.

*Polyzosteria invis*a, Walker, Cat. Blatt. Brit. Mus., p. 162 (1868).

Ovate and depressed. Dark purplish above; finely rugose-punctate, not tuberculate. Posterior margin of supra-anal lamina,

- 2'. Tibiae metallic blue or green . . . *E. nobilis*, Br.
- 1'. Margins of pronotum not or scarcely reflexed.
- 2. Lateral margins of pronotum broadly testaceous, disc aeneous . . . *E. patula*, Walk.
- 2'. Pronotum castaneous or greenish with 4 oblique testaceous stripes . . . *E. mitchellii*, Angas.

1. *E. subverrucosa*, White.

Blatta subverrucosa, White [*in*] Grey, Journ. Exped. Australia, ii, p. 467 (1841).

Polyzosteria reflexa, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 208 (1865).

Polyzosteria femoralis, Walker, Cat. Blatt. Brit. Mus., p. 156 (1868).

Polyzosteria figurata, Walker, op. cit., p. 157 (1868).

A common and well-known species; *figurata* is merely a larval form.

SOUTH and WESTERN AUSTRALIA.

2. *E. subreflexa*, Tepp.

Polyzosteria subreflexa, Tepp., Tr. R. Soc. S. Australia, xix, p. 158 (1895).

The diagnosis does not show how this species differs from the preceding.

SOUTH AUSTRALIA, Ooldea (Adelaide Mus., type).

3. *E. nobilis*, Br.

Polyzosteria nobilis, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 209 (1865).

Polyzosteria subnobilis, Tepp., Tr. R. Soc. S. Australia, xvii, p. 81 (1893).

Tepper failed to recognise Brunner's species, his description of *subnobilis* corresponds exactly with *nobilis*; the smooth spaces that he describes on the abdominal tergites are hidden in contracted examples.

SOUTH AUSTRALIA, Adelaide, Kangaroo Is.; WEST AUSTRALIA, Swan River (Vienna Mus., type; British Mus.; Oxford Mus.; Adelaide Mus., type of *subnobilis*).

4. *E. patula*, Walk. (Pl. VII, fig. 2.)

Polyzosteria patula, Walker, Cat. Blatt. Brit. Mus p. 157 (1868).

Broadly elliptical. Above dark aeneous-green, posterior margins of thoracic tergites narrowly testaceous interrupted by maculae of the ground colour, posterior margins of abdominal tergites with flavo-testaceous maculae. Dorsal surface finely rugose. Head aeneous, coarsely rugose; mouth-parts flavo-testaceous; antennae castaneous at base, remainder rufous. Pronotum with lateral margins slightly incrassated and elevated, laterally broadly testaceous, posterior angles slightly produced. Supra-anal lamina, (♂) subquadrangular, lateral margins serrate, (♀) rugose, trigonal, apex not emarginate. Cerci very short, not exceeding the lamina, testaceous. Posterior angles of 7th abdominal tergite scarcely produced, 8th abdominal tergites with spiracles visible at their external angles; external angles of 9th tergite produced as blunt processes. Beneath testaceous. Legs testaceous, with upper aspect of femora and tibiae brilliant metallic green.

Length (♂) 30 mm., (♀) 33 mm., pronotum (♂) 10 mm. × 20 mm., (♀) 11·5 mm. × 22 mm.

This is a somewhat aberrant species and appears to be intermediate between *Euzosteria* and *Anamesia*.

SOUTH AUSTRALIA, Northern Territory (British Mus., type; Adelaide Mus.); WESTERN AUSTRALIA, Towranna plains (Oxford Mus.).

5. *E. mitchellii*, Angas.

Blattamitchellii, Angas, S. Australia Illustr. Pl. XLVIII, fig. 1 (1847).

Polyzosteria mitchellii, Saussure, Mém. Sci. Phys. Nat. Genève, xxiii, p. 106 (1873); Tepper, Tr. R. Soc. S. Australia, xvii, p. 78 (1893); Froggatt, Australian Insects, p. 19, fig. 5 (1907).

Tepper describes the colours of fresh specimens, which are very brilliant. In the female the pronotum anteriorly is parabolic, whereas in the male it is widely arched and subsinuate, the measurements show the difference in form very clearly (♂ 10 mm. × 21 mm., ♀ 11 mm. × 21 mm.); this sexual dimorphism in the form of the pronotum is unusual.

VICTORIA; S. AUSTRALIA; WESTERN AUSTRALIA.

Genus 3. PLATYZOSTERIA, Br.

Platyzosteria, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 204 (1865).

Melanozosteria, Stål, Bih. Svensk. Akad. ii (13), p. 13, (1874).

Syntomaptera, Tepper, Tr. R. Soc. S. Australia, xvii, p. 106 (1893).

Drymaplaneta, Tepper, t. c., p. 109 (1893).

Characters. Ocelli absent. Antennae shorter than the body. Body depressed. Vertex of head not covered by pronotum. Pronotum not cucullate, its margins not reflected. Rudiments of tegmina present as squamiform lobes or absent. Wings absent. Posterior angles of all the abdominal tergites produced, those of the distal tergites strongly produced and spiniform. Supra-anal lamina variable in shape but never sub-bilobate in ♀. Genital styles long, slender, acuminate. Cerci frequently exceeding the supra-anal lamina, apex acuminate. Tibiae moderately spined, spines on outer aspect triseriately arranged. Posterior metatarsus very short, not spined beneath or with only a few spines, its pulvillus covering the greater part of the joint beneath.

Type of the genus—*P. melanaria*, Erichs.

Melanozosteria, Stål, is founded on a species of *Platyzosteria* erroneously identified as *nitida*, Br. *Syntomaptera*, Tepp., includes six species of *Platyzosteria* which the author quite incorrectly regards as allied to *Periplaneta*; Kirby for no obvious reason selects *scabriuscula*, Tepp., as the type of the genus (Syn. Cat. Orth., i, p. 129, 1904). *Drymaplaneta*, Tepp., is based on variable and larval characters and cannot possibly stand.

KEY TO THE SPECIES.

1. Uniform piceous or castaneous (cf., however, *P. bicolor*, Kirby).
2. Tegminal rudiments absent.
3. Dorsal surface not or only faintly scabrous.
4. Thoracic tergites not transversely seriate-punctate.
5. Vertex of head not orange rufous.

6. Supra-anal lamina, (♂)
sub-quadrate or trigonal,
apex emarginate, (♀)
triangular, not or scarcely
exceeding the cerci.
7. Large species (exceeding
25 mm.) *P. grandis*, Sauss.
- 7'. Smaller species.
8. Supra-anal lamina (♂)
with three or more
spines on either side
before the apex.
9. Supra-anal lamina,
(♂) scarcely em-
arginate at apex,
(♀) shorter than
its breadth at
base *P. melanaria*, Er.
- 9'. Supra-anal lamina,
(♂) deeply em-
arginate at apex,
(♀) longer than
its breadth at base. *P. unalis*, Sauss.
?P. pseudatrata, Tepp.
- 8'. Supra-anal lamina
(♂) not spined . . . *P. aterrima*, Er.
- 6'. Supra-anal lamina, (♂)
triangular, (♀) triangular
and considerably exceed-
ing the cerci.
7. Lateral margins of 7th
abdominal tergite
serrate or denticulate.
8. These margins denti-
culate *P. ferox*, sp. n.
- 8'. These margins serrate.
9. Lateral margins of
6th abdominal ter-
gite serrate . . . *P. armata*, Tepp.
- 9'. Lateral margins of
6th abdominal ter-
gite not serrate . . *P. rufofusca*, Tepp.
- 7'. Lateral margins of 7th
abdominal tergite not
serrate.

8. Lateral margins of supra-anal lamina (♂) serrate or minutely denticulate.
9. Posterior angle of 9th abdominal tergite bispinous . *P. bifida*, Sauss.
- 9'. Posterior angle of 9th abdominal tergite not bispinous. *P. atrata*, Er.
- 8'. Lateral margins of supra-anal lamina (♂) not serrate nor denticulate.
9. Large species (exceeding 30 mm.). *P. invisa*, Walk.
- 9'. Small species . . *P. consobrina*, Sauss.
- 5'. Vertex of head orange-rufous *P. ruficeps*, Shelf.
- 4'. Thoracic tergites transversely seriate-punctate *P. punctata*, Br.
- 3'. Dorsal surface distinctly scabrous.
4. Lateral margin of 7th abdominal tergite not serrate *P. variolosa*, Bol.
- 4'. Lateral margin of 7th abdominal tergite serrate.
5. Larger (27-31 mm.), antennæ fuscous, lateral margins of thorax not paler than disc *P. scabra*, Br.
- 5'. Smaller (19-23 mm.), antennæ rufous, lateral margins of thorax paler than disc . *P. scabrella*, Tepp.
- 2'. Tegminal rudiments present.
3. Tegminal rudiments on their inner side only half separated from the mesonotum.
4. Coxæ margined with testaceous.
5. Lateral margins of 7th abdominal tergite not serrate. *P. coxalis*, Walk.
- 5'. Lateral margins of 7th abdominal tergite serrate . . *P. biglumis*, Sauss.
- 4'. Coxæ not margined with testaceous.
5. Legs bright rufous *P. rufipes*, sp. n.

- 5'. Legs piceous or dark castaneous.
- 6. Small species (less than 16 mm.).
 - 7. 7th abdominal tergite with posterior margin subsinuate *P. biloba*, Sauss.
 - 7'. 7th abdominal tergite with posterior margin not subsinuate *P. perplexa*, sp. n.
- 6'. Larger species *P. curiosa*, Shelf.
- 3'. Tegminal rudiments on their inner side completely separated from the mesonotum.
- 4. An orange spot on each side of the 7th abdominal tergite . . *P. bicolor*, Kirby.
- 4'. No orange spots on the 7th abdominal tergite.
- 5. Apex of tegminal rudiments obliquely truncate *P. norae-seelandiae*, Br.
- 5'. Apex of tegminal rudiments tapering.
- 6. Coxae bordered with flavo-testaceous.
- 7. Castaneous, robust species *P. castanea*, Br.
- 7'. Piceous, narrower and smaller *P. obscura*, Tepp.
- 6'. Coxae unicolorous.
- 7. Meso- and meta-notum minutely scabrous . . *P. scabriuscula*, Tepp.
- 7'. Meso- and meta-notum smooth, nitid, with shallow punctures.
- 8. Small species (14 mm.) *P. rufoterminalata*, Br.
- 8'. Larger species.
- 9. Castaneous *P. pseudocastanea*, Tepp.
- 9'. Piceous.
- 10. Metanotum with two deeply impressed points . *P. ceratodi*, Krauss.
- 10'. Metanotum without these points.
- 11. Posterior margin of 7th ab-

dominal ter-
gite not den-
tate.

12. Legs piceous. *P. glabra*, Walk.

12'. Legs cas-
taneous . *P. conjuncta*, Shelf.

11'. Posterior mar-
gin of 7th ab-
dominal ter-
gite dentate . *P. morosa*, Shelf.

Species incertae sedis *P. provisionalis*, Tepp.

1'. Not uniform piceous or castaneous.

2. Castaneous or piceous with lateral
flavo-testaceous or white borders,
abdomen not transversely banded.

3. Tegminal rudiments absent.

4. Pale lateral borders not extend-
ing beyond 2nd abdominal
tergites, or if extending so far
much narrowed.

5. Small species (15 mm.) . . *P. inclusa*, Walk.

5'. Larger species.

6. Disc of pronotum not varie-
gated with paler colour . *P. albomarginata*, Br.

6'. Disc of pronotum varie-
gated with paler colour.

7. Coxae and femora castan-
eous; supra-anal lamina
(♂) with two large spines
at apex *P. brunnea*, Tepp.

7'. Coxae and femora test-
aceous, supra-anal lamina
(♂) without large spines
at apex *P. variegata*, Shelf.

4'. Pale lateral borders extending
at least to 5th abdominal
tergite.

5. Terminal abdominal sternites
not armed with spines . . *P. obscuripes*, Tepp.

5'. Terminal abdominal sternites
armed with spines *P. spenceri*, sp. n.

3'. Tegminal rudiments present.

4. Pale lateral borders not ex-
tending on to abdomen or

- represented on abdomen by a series of spots.
5. Pale lateral borders not extending inward to posterior margin of pronotum.
6. Sub-genital lamina (♂) with a spine at base of genital styles *P. soror*, Br.
- 6'. Sub-genital lamina (♂) without such spine.
7. Posterior tibiae of ♂ expanded and flattened . *P. semivitta*, Walk.
- 7'. Posterior tibiae of ♂ not expanded and flattened. *P. communis*, Tepp.
- 5'. Pale lateral border extending inward to posterior margin of pronotum *P. subbifasciata*, Tepp.
- 4'. Pale lateral borders extending on to abdomen.
5. Pale lateral borders not extending beyond 5th abdominal tergite *P. liturata*, Sauss.
- 5'. Pale lateral borders extending to 7th abdominal tergite. *P. circumducta*, Walk.
- Species incertae sedis *P. 6-guttata*, Walk.
P. balteata, Tepp.
P. latizona, Tepp.
- 2'. Ferruginous or transversely banded.
3. Tegminal rudiments absent.
4. Posterior angles of 9th abdominal tergite rounded . . . *P. coolgardiensis*, Tepp.
- 4'. Posterior angles of 9th abdominal tergite spiniform . . *P. aposematica*, sp. n.
- 3'. Tegminal rudiments present . . *P. hartmeyeri*, Shelf.
- Species incertae sedis *P. zebra*, Tepp.

1. *P. grandis*, Sauss.

Polyzosteria melanaria, var. *grandis*, Saussure, Mém. Soc. Sc. Phys. Nat. Genève, xxiii, p. 110 (1873).

This is a distinct species; though the form of the supra-anal lamina (♂) is almost the same as in *melanaria*, the margins of the abdominal tergites are more scabrous, the

stigmatic dots are more prominent, the coxæ are not bordered with testaceous, and the size is much larger.

VICTORIA, Melbourne (Geneva Mus., type), Western districts (Adelaide Mus.); S. AUSTRALIA, Adelaide (Oxford Mus.).

2. *P. melanaria*, Er. (Pl. VII, figs. 3a, 3b, 4.)

Periplaneta melanaria, Erichson, Arch. Naturg., viii, p. 247 (1842.)

There has been some confusion over this and the following species. I am much indebted to Dr. Th. Kuhlitz for comparing specimens with Erichson's type in the Berlin Museum; the following is a description of the species:—

Piceous, nitid, impunctate. Body depressed and rather narrow. Antero-lateral margins of pronotum very slightly incrassated. Antennæ piceous in basal third, remainder rufo-castaneous. Teg-minal rudiments absent. Supra-anal lamina, (♂) trigonal with 3-4 pairs of lateral spines, apex slightly emarginate and more or less rufo-fimbriate, (♀) triangular, cucullate, broader at base than its length, apex emarginate, the notch being rounded, margins dentate. Sub-genital lamina (♂) quadrate, posteriorly widely emarginate, a minute spine at the base of the genital styles which are slender and acuminate. Cerci longer than the supra-anal lamina in ♂, of equal length in ♀. Coxæ bordered with testaceous. Tibiæ and tarsi dark castaneous or piceous.

Length (♂ types) 25-30.5 mm., (♀ types) 28-28.5 mm.; pronotum 7 mm. × 10 mm.

TASMANIA (Berlin Mus., types; Oxford Mus.).

3. *P. analis*, Sauss.

Polyzosteria analis, Saussure, Rev. Zool. (2), xvi, p. 306 (1864).

Polyzosteria melanaria, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 210 (1865).

Periplaneta invisæ, Walker, Cat. Blatt. Brit. Mus., p. 137 (1868) (♂ only).

Periplaneta ruficornis, Walker, Cat. Derm. Salt. Brit. Mus. V. Suppl. Blatt., p. 38 (1871).

This is the mainland representative of *melanaria* and it may be necessary eventually to merge it in that species.

It differs in the following details which, though small, appear to be constant:—

Supra-anal lamina, (♂) with apex rather deeply though narrowly notched, the spines scarcely projecting but curved round close to the lateral margins, (♀) longer than breadth at base, apical emargination V-shaped, the apex of the V filled up by membranous tissue. Cerci shorter, tibiae and tarsi brighter castaneous.

NEW SOUTH WALES (Oxford Mus.); Tarangower (Vienna Mus.); VICTORIA, Narre Warren (Melbourne Mus.); WESTERN AUSTRALIA, Swan River (British Mus.); "BOMBAY" (British Mus. type of *ruficornis*).

The type of *analis* appears to be lost; *ruficornis* is absolutely identical with specimens in the Melbourne Museum which differ only from Oxford Museum examples in the castaneous margins to the thoracic tergites, castaneous abdominal disc and brighter castaneous tibiae and tarsi; these are mere colour varieties structurally identical with uniformly piceous specimens. The locality Bombay is probably erroneous or the unique specimen was an accidental importation from Australia. If it is eventually proved that *analis* , Sauss., is strictly conspecific with *melanaria* , Er., then *ruficornis* , Walk., must be applied to this species.

4. *P. pseudatrata*, Tepp.

Platyzozeria pseudatrata, Tepp., Tr. R. Soc. S. Australia, xvii, p. 86 (1893).

Known to me only from the description, which applies equally well to *P. melanaria* and *P. analis*.

CENTRAL AUSTRALIA (Adelaide Mus., type).

5. *P. aterrima*, Er. (Pl. VII, figs. 5 and 6.)

Periplaneta aterrima, Erichson, Arch. Naturg., viii, p. 248 (1842).

Periplaneta glabra, Tepp., Tr. R. Soc. S. Australia, xvii, p. 107 (1893).

Syntomaptera tepperi, Kirby, Ann. Mag. Nat. Hist. (7), xii, p. 374 (1903).

Specimens of *Syntomaptera glabra* determined by Tepp. in the Melbourne Museum are indistinguishable from *P. aterrima*, Er. I am again indebted to Dr. Kuhlitz for

help in determining this species and for sketches (reproduced here) of Erichson's types. The species may be re-described as follows:—

Piceous, nitid, impunctate, rather depressed. Antennae rufous, except a few basal joints which are piceous. Tegminal rudiments absent. Supra-anal lamina, (♂) sub-quadrate, exceeded by the cerci and sub-genital lamina, posterior margin scarcely emarginate, angles not rounded, fimbriate, margins not serrate, (♀) trigonal, rather shorter than cerci, apex very slightly emarginate, margins serrate. Sub-genital lamina (♂) scabrous, quadrate. Coxae unicolorous, legs piceous.

Length (type ♂) 12 mm., (type ♀) 16 mm.; pronotum 4 mm. × 6 mm.

TASMANIA (Berlin Mus., types; Oxford Mus.; Vienna Mus.); NEW SOUTH WALES, Sydney (*W. W. Froggatt*); VICTORIA (Melbourne Mus.); SOUTH AUSTRALIA, Northern territory (Adelaide Mus.).

6. *P. ferox*, sp. n. (Pl. VII, figs. 7a, 7b.)

♂. Piceous, nitid, impunctate, laterally finely scabrous. Lateral margins of thoracic tergites slightly incrassated. Tegminal rudiments absent. Angles of abdominal tergites 5–9 produced as acute spines, lateral margins of tergites 6 and 7 strongly denticulate. Supra-anal lamina sharply triangular, apex terminating in two spines, margins serrate. Cerci short, acuminate. 6th and 7th sternites with a complete row of spines on their posterior margins, these spines on the 4th and 5th sternites confined to the lateral parts of the posterior margins. All the sternites finely tuberculate laterally. Sub-genital lamina quadrate, scabrous, genital styles stout, spiniform, exceeding the cerci in length. Legs unicolorous, piceous.

Total length 33 mm.; pronotum 8 mm. × 12 mm.

CENTRAL AUSTRALIA (*Spencer-Gillen Expedition*), (Melbourne Mus., type; Oxford Mus.).

7. *P. armata*, Tepp. (Pl. VII, figs. 8, 9.)

Platyzoisteria armata, Tepper, Tr. R. Soc. S. Australia, xvii, p. 84 (1893).

Dark castaneous, nitid, minutely punctate, laterally finely scabrous. Antennae rufous, except for castaneous basal joint. Pronotum with impressions and inconspicuous rugosities. No tegminal rudiments.

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Angles of abdominal tergites 6-8 produced as blunt spines. Lateral margins of tergites 6 and 7 denticulate-serrate. Supra-anal lamina, (♂) sharply triangular terminating in two spines, each with a small spine at its base and a smaller one further back, (♀) triangular, apex deeply cleft, lateral margins with 7 teeth. Sub-genital lamina (♂) quadrate. Posterior margin faintly emarginate, scabrous, genital styles stout, acuminate, slightly incurved. Disc of abdomen beneath piceous, scabrous. Coxae and femora rufo-castaneous, tibiae castaneous.

Total length (♂) 35 mm., (♀) 36 mm.; pronotum 9.5 mm. × 16 mm.

WEST AUSTRALIA, Fraser Range (Adelaide Mus., types); Mt. Robinson, Coolgardie (*Michaelsen* and *Hartmeyer*), (Hamburg Mus.; Oxford Mus.).

8. *P. rufofusca*, Tepp.

Platyzozeria rufofusca, Tepper, t. c., p. 84 (1893).

Unknown to me, except from the description. The form of the supra-anal lamina in the ♀ appears to distinguish it from the preceding species.

SOUTH AUSTRALIA, Gilbert River (Adelaide Mus., type).

9. *P. bifida*, Sauss. (Pl. VII, fig. 10.)

Polyzozeria bifida, Saussure, Mém. Soc. Sci. Phys. Nat. Genève, xxiii, p. 110, Pl. X, f. 37 (1873).

The species resembles *P. invisæ*, Walk., but is readily distinguished by the form of the supra-anal and sub-genital laminae in the male, the angle of the 9th tergite moreover is bispinous, a character not met with in other species of the genus.

QUEENSLAND (Geneva Mus., type).

There is one example in the Oxford Museum from the Burr collection labelled "Brazil," the locality is evidently incorrectly given.

10. *P. atrata*, Er. (Pl. VIII, fig. 14.)

Periplaneta atrata, Erichson, Arch. Naturg., viii, p. 248 (1842).

Dr. Kuhlitz has favoured me with a drawing of the supra-anal lamina of the ♂ type; it is triangular, emarginate at the apex and serrated laterally, it is consequently very like the supra-anal lamina of *P. melanaria* ♀.

The types measure 22-23 mm. in length. Specimens from Melbourne and W. Australia have the thoracic tergites margined with rufo-castaneous and the tibiae partly rufo-castaneous but otherwise appear to be the same as the typical form.

TASMANIA (Berlin Mus., types); NEW SOUTH WALES, Tarangower (Vienna Mus.); VICTORIA, Melbourne (Melbourne Mus.); WESTERN AUSTRALIA, Boorabbin (*Michaelsen* and *Hartmeyer*), (Hamburg Mus.; Oxford Mus.).

11. *P. invis*a, Walk. (Pl. VIII, figs. 15, 16.)

*Periplaneta invis*a, Walker, Cat. Blatt. Brit. Mus., p. 137 (1868), (♀ only).

Piceous, nitid, impunctate, margins of segments rather scabrous. Antennae in basal third piceous, remainder rufo-castaneous. No tegminal rudiments. Abdominal stigmatic dots very distinct. Supra-anal lamina, (♂) triangular, apex deeply notched, a short spine on either side of the notch, (♀) triangular, longer than in *P. melanaria*, cucullate, apex deeply emarginate, lateral margins 4-dentate. Cerci longer than supra-anal lamina in ♂, shorter in ♀. Subgenital lamina (♂) quadrangular, scabrous without a spine at base of styles.

Length (♂) 33.5 mm., (♀) 31 mm.; pronotum 8 mm. × 12-13 mm.

WESTERN AUSTRALIA, Swan River (Oxford Mus., ♂ type; British Mus., ♀ type); NEW SOUTH WALES, Gosford (*W. W. Froggatt*) (Oxford Mus.).

12. *P. consobrina*, Sauss.

Polyzosteria consobrina, Saussure, Rev. Zool. (2) xvi, p. 306 (1864).

The identity of this species is very uncertain and the type appears to be lost; it may be merely a larval form of *invis*a or identical with *atrata*, the latter appears to be more likely.

"AUSTRALIA."

13. *P. ruficeps*, Shelf.

Platyzosteria ruficeps, Shelford, [*in*] Fauna Südwest Austral., ii, Lief. 9, Blattidae, p. 134, Pl. XIII, fig. 3 (1909).

WESTERN AUSTRALIA, Moora (*Michaelsen* and *Hartmeyer*), (Hamburg Mus., type).

14. *P. punctata*, Br. (Pl. VII, fig. 11, Pl. VIII, figs. 17a, 17b.)
Polyzosteria punctata, Brunner von Wattenwyl, Nouv.
 Syst. Blatt., p. 211 (1865).

The nearest ally of this species is perhaps *aterrima*, Er., but *punctata* is narrower. The seriately arranged shallow punctures on the thoracic tergites are distinctive; the supra-anal lamina is scabrous and the lateral margins of the 7th abdominal tergite are slightly serrate.

NEW SOUTH WALES, Sydney (Vienna Mus., type).

15. *P. variolosa*, Bol. (Pl. VII, fig. 13.)
Polyzosteria variolosa, Bolivar, Ann. Soc. ent. France
 (6) ii, p. 460 (1882).

In the female the supra-anal lamina is produced, cucullate, posteriorly widely emarginate, with acute angles, lateral margins entire.

NEW CALEDONIA, Noumea (Bolivar); ÎLE DES PINS (Oxford Mus.).

16. *P. scabra*, Br.
Polyzosteria scabra, Brunner von Wattenwyl, Nouv.
 Syst. Blatt., p. 213 (1865).
Polyzosteria tarsalis, Walker, Cat. Blatt. Brit. Mus., p.
 162 (1868).

NEW SOUTH WALES, Sydney (Vienna Mus., type of *scabra*), Port Hacking (*W. W. Froggatt*), (Oxford Mus.); "AUSTRALIA" (British Mus., type of *tarsalis*).

17. *P. scabrella*, Tepp.
Platyzosteria scabrella, Tepp., Tr. R. Soc. S. Australia,
 xvii, p. 88 (1893).

This should be readily recognisable from the description; it can be distinguished from the preceding species by its smaller size, the rufous antennae and by the wide emargination of the sub-genital lamina of the ♂. The supra-anal lamina of the ♂ is subquadrate with rounded angles, there are three short teeth on either side near the apex.

SOUTH AUSTRALIA, various localities (Adelaide Mus., types); NEW SOUTH WALES, Gunnedah (*W. W. Froggatt*), (Oxford Mus.).

18. *P. coxalis*, Walk.

Polyzosteria coxalis, Walker, Cat. Derm. Salt. Brit. Mus. V. Suppl. Blatt., p. 35 (1871).

♂. Above rufo-castaneous, abdominal tergites with lateral piceous blotches increasing in size distally. Below piceous with disc of abdomen castaneous. Head rufo-castaneous. Thorax smooth, nitid; abdominal tergites somewhat scabrous. Tegminal rudiments semi-articulated. Lateral angles of 8th tergite not spinously produced but lobiform as in *Cosmozosteria* and yellow. Supra-anal lamina quadrate, posteriorly widely emarginate, posterior angles slightly produced, lateral margins serrate. Cerci scarcely exceeding the lamina. Sub-genital lamina quadrate, a minute spine at base of genital styles. Coxae bordered with yellow, femora rufous, tibiae castaneous.

Length 20 mm. ; pronotum 6 mm. \times 9 mm.

BOMBAY (British Mus., type).

19. *P. biglumis*, Sauss.

Polyzosteria biglumis, Saussure, Rev. Zool. (2) xvi, p. 305 (1864).

Polyzosteria subaptera, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 212 (1865).

A very variable species both in colour, which ranges from piceous to castaneous, and in size. It can be distinguished by the semi-articulated tegmina, scabrous distal tergites and coxae margined with testaceous.

NEW SOUTH WALES (Oxford Mus.), Sydney (Stockholm Mus.); VICTORIA, Melbourne (Geneva Mus., type of *biglumis*); SOUTH AUSTRALIA, Adelaide (Vienna Mus., types of *subaptera*).

The examples in the Stockholm Museum are much larger than the type, the tegminal rudiments are slightly more articulated and the angles of the 8th abdominal tergites are yellow. The Oxford Museum specimens are intermediate between this form and the typical form.

20. *P. perplexa*, sp. n.

♂. Allied to *P. biglumis*, Sauss., but differing in the smaller size, rufous antennae, unicolorous coxae and in the almost entire absence of denticulations from the supra-anal lamina. The lateral margins of the 7th abdominal tergite are not serrate.

Length 13 mm. ; pronotum 4 mm. \times 5.8 mm.

TASMANIA (Oxford Mus., type).

This may be merely a local variety of the preceding species and I only regard it provisionally as distinct.

21. *P. rufipes*, sp. n.

Piceous, nitid. A few minute punctures on the thoracic tergites, distal abdominal tergites minutely scabrous, especially in the ♀. Pro- and meso-notum laterally bordered with rufo-castaneous. Head piceous, antennae rufo-castaneous. Tegminal rudiments semi-articulated. Lateral margins of 7th abdominal tergite not serrate. Supra-anal lamina, (♂) trigonal, apex truncate, scarcely emarginate, lateral margins minutely serrate. Cerci exceeding the supra-anal lamina in both sexes. Sub-genital lamina (♂) subquadrate, a spine at the base of each genital style equal to half the length of the style. Coxae not bordered with testaceous, piceous, femora, tibiae and tarsi rufous. Posterior metatarsi rather longer than usual in this genus and armed beneath with a few spines.

Length 11-12.5 mm.; pronotum 4 mm. × 6 mm.

WESTERN AUSTRALIA (Oxford Mus., types ♂ and ♀).

22. *P. biloba*, Sauss.

Polyzosteria biloba, Saussure, Mém., Soc. Sci. Phys. Nat. Genève, xx, p. 258, Pl. III, f. 20 (1869).

Known to me from the description only.

AMBOINA (Geneva Mus., type).

23. *P. curiosa*, Shelf.

Platyzoisteria curiosa, Shelford, [*in*] Fauna Südwest Austral., ii, Lief. 9, Blattidae, p. 135, Pl. XIII, figs. 11, 12 (1909).

A very remarkable species. A specimen in the Oxford Museum I refer with some doubt to this species, since the legs are rufo-castaneous in colour and the cerci are shorter than the supra-anal lamina.

WESTERN AUSTRALIA, Northam (*Michaelsen and Hartmeyer*), (Hamburg Mus., type); "NEW HOLLAND" (Oxford Mus.).

24. *P. bicolor*, Kirby.

Melanozosteria bicolor, Kirby, Ann. Mag. Nat. Hist. (7) xii, p. 373 (1903).

A well-marked species.

TORRES STRAITS, Cornwallis Island (British Mus., type; Oxford Mus., co-type).

25. *P. novae-seelandiae*, Br. (Pl. VII, fig. 12.)

Polyzosteria novae-seelandiae, Brunner von Wattenwyl, *Nouv. Syst. Blatt.*, p. 218 (1865).

Periplaneta fortipes, Walker, *Cat. Blatt. Brit Mus.*, p. 137 (1868).

This can readily be recognised by the obliquely truncate and strongly punctate tegmina.

NEW ZEALAND (Vienna Mus., type of *novae-seelandiae*; British Mus., type of *fortipes*; Oxford Mus.).

Two or three species are included in the British Museum collection under the heading *fortipes* and the type is not indicated; I follow Kirby in regarding the species as synonymous with *novae-seelandiae* because Walker's New Zealand specimens are undoubtedly identical with Brunner's types. It is not often that the dreary pages of Walker's Catalogues contain any notes of biological interest but in his list of specimens of *fortipes* one is recorded as having been found under the bark of trees devouring bugs. The observation is of interest because it lends some support to the truth of the statement which has been made, though with some scepticism, that the detestable pest, *Periplaneta americana*, devours the loathsome bed bug.

26. *P. castanea*, Br. (Pl. VIII, figs. 18a, 18b.)

Polyzosteria castanea, Brunner von Wattenwyl, *Nouv. Syst. Blatt.*, p. 214 (1865).

Platyzosteria avocaensis, Tepper, *Tr. R. Soc. S. Australia*, xvii, p. 88 (1893).

Platyzosteria exaspera, Tepper, *op. cit.* xviii, p. 182 (1894).

I have seen examples of *avocaensis* and *exaspera* determined by Mr. Tepper himself; the former is the female of the latter and both are synonymous with *castanea*, the type of which I have also seen.

P. castanea shows distinct affinities with *Cosmozosteria*, the angles of the abdominal tergites except the 7th being scarcely produced. The cerci are very short in this species.

NEW SOUTH WALES, Tarangower, Sydney (Vienna Mus., types of *castanea*; Stockholm Mus. (*Godeffroy*); Oxford Mus. (*W. W. Froggatt*)), Avoca (Adelaide Mus., type of *avocaensis*); VICTORIA (Adelaide Mus., type of *exaspera*).

27. *P. obscura*, Tepp. (Pl. VIII, fig. 19.)

Periplaneta obscura, Tepper, Tr. R. Soc. S. Australia, xvii, p. 107 (1893).

With some doubt I refer two ♂♂ in the Hamburg and Oxford Museums to this species.

Piceous, nitid, impunctate except for a few faint punctures on the distal tergites. Antennae fuscous. Tegminal rudiments present, not quite completely articulated. Supra-anal lamina trigonal, apex truncate, rather deeply emarginate, lateral margins entire, faintly concave, exceeded by cerci. Sub-genital lamina quadrate, posterior margin concave, no spine at base of styles. Coxae narrowly bordered with testaceous. Legs piceous.

Length 20.1 mm. ; pronotum 5.1 mm. × 8 mm.

SOUTH AUSTRALIA, Northern Territory (Adelaide Mus., type); WEST AUSTRALIA, Fremantle (*Michaelsen* and *Hartmeyer*), (Hamburg Mus. ; Oxford Mus.).

The species which was originally described from a ♀ only cannot be recognised with any real certainty.

28. *P. scabriuscula*, Tepp. (Pl. VIII, fig. 20.)

Periplaneta scabriuscula, Tepper, op. cit., p. 108 (1893).

Piceous, nitid, dorsal surface with minute acute tubercles most marked on the middle abdominal tergites. Tegminal rudiments present and completely articulated. Posterior margin of 7th abdominal tergite sinuate, its posterior angles not very strongly produced. Supra-anal lamina, (♂) quadrate, lateral margins entire, posterior margin concave, rufo-fimbriate, (♀) triangular, cucullate, apex truncate, emarginate, lateral margins entire. Cerci exceeding the supra-anal lamina in both sexes. Sub-genital lamina (♂) quadrate. Coxae not bordered with testaceous ; legs castaneous.

Length 12-17 mm. ; pronotum 4.5 mm. × 7-7.5 mm.

SOUTH AUSTRALIA, various localities (Adelaide Mus., types); WEST AUSTRALIA (Hamburg Mus. and Oxford Mus. (*Michaelsen* and *Hartmeyer*)).

29. *P. rufoterminalata*, Br. (Pl. IX, fig. 30.)

Polyzosteria rufoterminalata, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 219 (1865).

Described from a ♀ only. It is characterised by the rows

of shallow punctures on the dorsal surface, the rufo-castaneous tegminal rudiments, the supra-anal lamina with entire margins and non-emarginate apex.

"NEW HOLLAND" (Vienna Mus., type).

30. *P. pseudocastanea*, Tepp.

Platyzosteria pseudocastanea, Tepper, Tr. R. Soc. S. Australia, xvii, p. 89 (1893).

Known to me only from the description; it appears to differ from *castanea*, Br., by the unicolorous coxae, and the scabrous supra-anal lamina (♂) with dentate lateral margins and emarginate apex.

S. AUSTRALIA, Tanunda, Ardrossan (Adelaide Mus., type).

31. *P. ceratodi*, Kr.

Polyzosteria ceratodi, Krauss, Denkschr. med.-nat. Ges. Jena, viii, p. 751 (1903).

Known to me only from the description.

QUEENSLAND, Burnett (*Semon*) (Jena University Mus., type).

32. *P. glabra*, Walk.

Periplaneta glabra, Walker, Cat. Blatt. Brit. Mus., p. 139 (1868).

♂. Piceous, nitid, impunctate, rather broad. Tegminal rudiments present and completely articulated. Supra-anal lamina quadrate, depressed in middle, lateral margins entire, posteriorly widely emarginate, exceeded by the cerci. Sub-genital lamina widely emarginate, a short blunt spine at the base of the long genital styles. Posterior margin of 7th abdominal tergite not dentate. Coxae not bordered with testaceous.

Length 20 mm.; pronotum 7 mm. × 10.9 mm.

"AUSTRALIA" (British Mus., type).

This species in its general facies closely resembles *Cutilia nitida*, Br., but can readily be distinguished from that by its tarsal structure.

33. *P. conjuncta*, Shelf.

Platyzosteria conjuncta, Shelford, [in] *Fauna Südwest Austral.*, ii, Lief. 9, Blattidae, p. 136 (1909).

This can be distinguished from the preceding by the spines at the posterior angles of the supra-anal lamina (♂), from *obscura* by the form of the sub-genital lamina (♂), and from *scabriuscula* by the absence of scabrous points on the dorsal surface.

WEST AUSTRALIA, Collie (*Michaelsen* and *Hartmeyer*), (Hamburg Mus., types).

34. *P. morosa*, Shelf. (Pl. VIII, fig. 21.)

Platyzosteria morosa, Shelford, op. cit., p. 136 (1909).

Distinguished from the preceding by the form of the supra-anal lamina (♂); the species varies considerably in size.

SOUTH AUSTRALIA (Oxford Mus., types); WEST AUSTRALIA, S. Albany, Lion Mill, Mundaring Weir (*Michaelsen* and *Hartmeyer*), (Hamburg Mus.).

35. *P. provisionalis*, Tepp.

Periplaneta provisionalis, Tepper, Tr. R. Soc. S. Australia, xvii, p. 108 (1893).

This species cannot be recognised from the description; some specimens in the Melbourne Museum, identified by Mr. Tepper as *provisionalis*, are young larvae that cannot be referred with any certainty to this or to any other species of the genus.

SOUTH AUSTRALIA, Mount Bryan East (Adelaide Mus., type).

36. *P. inclusa*, Walk.

Periplaneta inclusa, Walker, Cat. Blatt. Brit. Mus., p. 140 (1868).

Platyzosteria inclusa, Shelford, [in] *Fauna Südwest Austral.*, ii, Lief. 9, Blattidae, p. 137, Pl. XIII, fig. 4 (1909).

Piceous above, sometimes variegated with castaneous on the disc of the thorax, nitid, impunctate. Thorax margined laterally with testaceo-hyaline. Head and legs rufous. Antennae rufo-castaneous. No tegminal rudiments. Posterior angles of abdominal tergites

scarcely produced backwards in ♂. Supra-anal lamina, (♂) subquadrate, apex widely emarginate, lateral margins entire, (♀) cucullate, triangular, apex emarginate, lateral margins entire, exceeded by the cerci. Sub-genital lamina (♂) with posterior margin slightly produced.

Total length (♂) 14·8 mm., (♀) 16 mm. ; pronotum 4·4·8 mm. × 5·5·8 mm.

WEST AUSTRALIA, various localities (British Mus., type ; Oxford Mus. ; Hamburg Mus. (*Michaelsen* and *Hartmeyer*)).

37. *P. albomarginata*, Br. (Pl. VIII, fig. 22.)

Polyzosteria albomarginata, Brunner von Wattenwyl,
Nouv. Syst. Blatt., p. 212 (1865).

Brunner's description is drawn up from a larval specimen, the following is a description of the adult male :—

Piceous, nitid, impunctate. Antennae rufescent except at base. Thoracic tergites faintly carinate, laterally bordered with flavo-testaceous, the borders being outwardly margined rather broadly with piceous. Tegminal rudiments absent. Lateral margin of 7th abdominal tergite finely serrate. Supra-anal lamina triangular, apex incised, lateral margins serrate. Cerci equal in length to the lamina. Sub-genital lamina quadrate, scabrous, styles stout. Legs rufo-castaneous.

Length 34 mm. ; pronotum 9 mm. × 13·8 mm.

NEW SOUTH WALES, Sydney (Vienna Mus., type) ; WEST AUSTRALIA, Coolgardie (Hamburg Mus.), Kalgoorlie (coll. Froggatt.)

38. *P. brunnea*, Tepp.

Platyzosteria albomarginata, var. *brunnea*, Tepper, Tr.
R. Soc. S. Australia, xvii, p. 86 (1893).

This appears to be quite distinct from the preceding, but I have seen no examples.

S. AUSTRALIA, Gilbert River, Kangaroo Is. ; CENTRAL AUSTRALIA, Barrow range (Adelaide Mus., types).

39. *P. variegata*, Shelf.

Platyzosteria variegata, Shelford, [*in*] Fauna Südwest Austral., ii, Lief. 9, Blattidae, p. 137, Pl. XIII, fig. 14 (1909).

Distinguished from the two preceding species, its nearest allies, by the form of the supra-anal lamina (♂).

WEST AUSTRALIA, Boyanup (*Michaelsen* and *Hartmeyer*), (Hamburg Mus., type).

40. *P. obscuripes*, Tepp. (Pl. VIII, fig. 23.)

Drymaplaneta obscuripes, *Tepper*, Tr. R. Soc. S. Australia, xvii, p. 112 (1893).

I have seen no mature examples of this, and strongly suspect it of being the larva of one of the three preceding species. The larval condition of the ♀ sub-genital valves is employed by *Tepper* as one of the diagnostic characters of his genus *Drymaplaneta*!

SOUTH AUSTRALIA, West coast; WEST AUSTRALIA, Fraser range (Adelaide Mus., types), Swan river (Oxford Mus.).

41. *P. spenceri*, sp. n.

♂. Piceous, nitid, impunctate. Disc of abdomen beneath rufo-castaneous. Margined all round continuously with flavo-testaceous, outlined outwardly with piceous; the supra-anal lamina and cerci piceous or castaneous. Tegminal rudiments absent. Posterior angles of all the abdominal tergites very acutely produced, especially the 8th. Lateral margins of 6th tergite serrate, of 7th denticulate. Supra-anal lamina acutely triangular, terminating in a pair of diverging spines, lateral margins denticulate. Cerci not exceeding the supra-anal lamina. Terminal sternites laterally finely tuberculate. Posterior margin of 6th abdominal sternite strongly denticulate, posterior margins of the two preceding sternites laterally with smaller denticles. Sub-genital lamina small, sub-quadrate, styles very stout, incurved, equal to the cerci. Coxae narrowly bordered with testaceous. Legs piceous.

Length 28 mm.; pronotum 7 mm. × 10 mm.

CENTRAL AUSTRALIA (*Spencer-Gillen expedition*), (Melbourne Mus., type; Oxford Mus., co-type).

42. *P. soror*, Br. (Pl. VIII, figs. 24a, 24b.)

Polyzosteria soror, *Brunner von Wattenwyl*, *Nouv. Syst. Blatt.*, p. 219 (1865).

Periplaneta semicineta, *Walker*, *Cat. Blatt. Brit. Mus.*, p. 140 (1868).

This is the insular form of the next species; it can be

distinguished by its smaller size, more convex shape, the outer border of the flavo-testaceous thoracic margins not distinctly margined with castaneous, the genital styles with a spine at their base and by the supra-anal lamina (♀) being less emarginate at the apex. The species varies in size, New Caledonian examples being the smallest, Bornean examples the largest.

AMBOINA (Vienna Mus., type of *soror*); CERAM (British Mus.); NAVIGATOR'S IS. (Brit. Mus., type of *semivittata*); NEW CALEDONIA (Oxford Mus.); NEW HEBRIDES (Melbourne Mus.); TONGA (Stockholm Mus.); BORNEO (Oxford Mus.); FORMOSA (British Mus.).

43. *P. communis*, Tepp. (Pl. VIII, figs. 25a, 25b.)

Drymaplaneta communis, Tepper, Tr. R. Soc. S. Australia, xvii, p. 110 (1893).

Methana antipodum, Brancsik, Jahresh. Ver. Trencsin. Com. xix-xx, p. 58, Pl. I, fig. 4 (1897).

QUEENSLAND (Oxford Mus.); SOUTH AUSTRALIA, various localities (Adelaide Mus., type of *communis*; Oxford Mus., type of *antipodum*); WEST AUSTRALIA, Swan River (Oxford Mus.).

44. *P. semivittata*, Walk. (Pl. VIII, figs. 26a to 26f.)

Periplaneta semivittata, Walker, Cat. Blatt. Brit. Mus., p. 143 (1868).

Piceous or dark castaneous above, nitid, impunctate. Thoracic tergites laterally bordered with clear flavo-testaceous, outwardly narrowly margined with castaneous. Head testaceous, a castaneous band on vertex and a castaneous blotch on frons, antennae rufo-castaneous. Maxillary palpi (♂) with 1st and 2nd joint swollen. Labrum sub-bilobate. Tegminal rudiments present, subtruncate at apex. 1st abdominal tergite (♂) with a circular gland-opening fringed with rufous setae.* Supra-anal lamina, (♂) quadrate, angles acute but not produced, posterior margin slightly emarginate, lateral margins entire, (♀) cucullate, triangular, apex deeply notched. Sub-genital lamina (♂) trapezoidal, produced, apex widely emarginate, styles placed sub-laterally. Cerci surpassing the supra-anal lamina in both sexes. Coxae testaceous, blotched with castaneous. Femora rufo-castaneous, anterior pair paler; tibiae castaneous. Posterior tibiae (♂) very stout, flattened and expanded.

Total length (♂) 24, (♀) 25 mm.; pronotum 7 mm. × 9 mm.

* This is frequently hidden under the metanotum.

WESTERN AUSTRALIA, Swan River (British Mus., type); SOUTH AUSTRALIA, various localities (*Michaelsen* and *Hartmeyer*), (Hamburg Mus.; Oxford Mus.).

This is a somewhat anomalous form as shown by the curious secondary sexual characters of the male.

45. *P. sub-bifasciata*, Tepp.

Drymaplaneta sub-bifasciata, Tepper, Tr. Roy. Soc. S. Australia, xvii, p. 112 (1893).

Evidently described from a larva. There is an adult ♀ in bad condition and without label in the Oxford Museum; in this the lateral yellow border of the thoracic tergites is interrupted at the mesonotum by the tegminal rudiments, which are piceous. The species is readily recognisable by the production, along the hind-margins of the pro- and meta-notum, of the lateral yellow border.

SOUTH AUSTRALIA, Northern territory (Adelaide Mus., type).

46. *P. liturata*, Sauss.

Polyzosteria liturata, Saussure, Mém. Soc. Sci. Phys. Nat. Genève, xxiii, p. 108, Pl. X, fig. 36 (1873).

Known to me only from the description.

NEW GEORGIA (Geneva Mus., type).

47. *P. circumducta*, Walk.

Periplaneta circumducta, Walker, Cat. Blatt. Brit. Mus., p. 143 (1868).

Drymaplaneta submarginata, Tepper, Tr. R. Soc. S. Australia, xvii, p. 111 (1893).

Closely allied to *P. soror*, Br., but the flavo-testaceous border runs completely round the body including the anterior margin of the pronotum and so much as is visible of the 8th abdominal tergite. Supra-anal lamina (♂) quadrate, margins entire, posteriorly not emarginate. A small spine at base of styles.

? *Loc.* (British Mus., type of *circumducta*); SOUTH AUSTRALIA, Kangaroo Is., Mount Lofty range (Adelaide Mus., type of *submarginata*).

48. *P. sexguttata*, Walk.

Periplaneta sexguttata, Walker, Cat. Blatt. Brit. Mus., p. 141 (1868).

This is a very young larva.

"AUSTRALIA" (British Mus., type).

49. *P. balteata*, Tepp.

Platyzosteria balteata, Tepp., Tr. R. Soc. S. Australia, xvii, p. 91 (1893).

I have been quite unable to recognise this and the next species; their generic position is problematical.

50. *P. latizona*, Tepp.

Platyzosteria latizona, t. c., p. 92 (1893).

SOUTH AUSTRALIA, Mount Bryan East (Adelaide Mus., type).

51. *P. coolgardiensis*, Tepp. (Pl. VIII, fig. 27.)

Platyzosteria coolgardiensis, Tepp., op. cit., xix, p. 159 (1894).

♂. Rufo-testaceous, impunctate, opaque. Disc of thoracic tergites, a band on each abdominal tergite, disc of abdomen beneath, tibiae and tarsi castaneous or rufo-castaneous. Tegminal rudiments absent. Posterior angles of abdominal tergites 2-5 scarcely produced, of tergites 6-7 strongly produced, of tergite 9 sub-lobiform. Lateral margins of 6th and 7th abdominal tergites finely serrate. Supra-anal lamina triangular terminating in two slender spines, barely exceeding the cerci in length. Subgenital lamina trapezoidal, posteriorly very slightly emarginate, styles stout, acuminate. Posterior metatarsi not spined beneath; its pulvillus apical.

Length 24 mm.; pronotum 6 mm. × 10 mm.

WEST AUSTRALIA, Coolgardie (Adelaide Mus., type), Kalgoorlie (*W. W. Froggatt*), (Oxford Mus.).

The above description is drawn up from a specimen determined by Mr. Tepp and kindly presented to the Oxford Museum by Mr. Froggatt. The species is an anomalous one, but seems to fit sufficiently into the genus *Platyzosteria*.

52. *P. aposematica*, sp. n. (Pl. IX, fig. 29.)

♀. Pale ferruginous above, disc of pro- and mesonotum, posterior margins of abdominal tergites, 9th tergite, supra-anal lamina and cerci, piceous. Abdomen beneath piceous with the disc castaneous; legs castaneous. Tegminal rudiments absent. Lateral margins of 6th and 7th abdominal tergites serrate, posterior angles strongly produced. Posterior angles of 9th tergite spiniform. Supra-anal lamina triangular, apex notched, lateral margins denticulate. Cerci of equal length with the lamina. Ultimate and penultimate sternites laterally scabrous, posterior margins laterally finely dentate.

Length 40 mm. ; pronotum 9.6 mm. × 13 mm.

CENTRAL AUSTRALIA (*Spencer-Gillen Expedition*), (Melbourne Mus., type).

It is rather remarkable that the three Central Australian species described here should show the same tendency to spinosity of the terminal abdominal segments.

53. *P. hartmeyeri*, Shelf.

Platyrosteria hartmeyeri, Shelford [*in*] Fauna Südwest Austral., ii, Lief. 9, Blattidae, p. 138 (1909).

WEST AUSTRALIA, Boorabbin (Hamburg Mus., type).

54. *P. zebra*, Tepp.

Polyzosteria zebra, Teppel [*in*] Horn Exped. Centr. Australia, ii, p. 362 (1896).

I am unable to determine the correct systematic position of this species; the original description is quoted herewith:—

“♀. Yellow, banded with piceous, stout. Vertex, a band between and below the antennae, base of clypeus, and a longitudinal stripe reddish-piceous. Antennae and palpi reddish. Pronotum scarcely hooded, not much reflexed laterally, almost smooth, shining, disc indistinctly impressed with very faint dark spots; hind angles subacute; hind margin concave. Meso- and metanotum similar, each side with small shallow pits, a dark band rather broad in the middle and convex behind, short; hind margin of metanotum slightly and angularly produced in the middle. Abdomen almost smooth, except a few scattered pits, dark basal band narrow, not extending to lateral margin, posterior angles rectangular or shortly produced as a small tooth. Legs bicolorous; coxae pale testaceous,

anterior border, base and a short stripe in the middle reddish-brown; femora with inner side pale testaceous, remainder reddish; tibiae and tarsi reddish-piceous; arolia large. Abdomen ventrally pale yellowish, each segment with a narrow dark basal band extending to lateral margin. Cerci as long as lamina, slender, pale yellow, terminating in a short spine.

"Total length 35 mm.; pronotum 9 mm. \times 19 mm."

CENTRAL AUSTRALIA.

Genus 4. LEPTOZOSTERIA, Tepp.

Leptozosteria, Tepp., Tr. R. Soc. S. Australia, xvii, p. 96 (1893).

Characters. "Body very flat and thin, elongate. Integument soft. Supra-anal lamina of male triangular, terminating in an acute apical spine. Colour pale with dark bands."

The only species of this genus which I have seen is *L. secunda*, Tepp., and that is undoubtedly conspecific with *Cutilia triangulata*, Br. (q. v.). The only important character in Tepp's generic diagnosis is the form of the male supra-anal lamina, and as there are many objections to founding new genera on male secondary sexual characters alone, I expect that it will eventually be necessary to sink *Leptozosteria* as a synonym of *Platyzozeria* or of *Cutilia*.

1. *L. prima*, Tepp.

Leptozosteria prima, Tepp., t. c., p. 96 (1893).

CENTRAL AUSTRALIA, Cordilho Downs (Adelaide Mus., type).

Genus 5. CUTILIA, Stål.

Cutilia, Stål, Oefv. Vet. Akad. Förh., xxxiv (10), p. 36 (1877).

Characters. Closely allied to *Platyzozeria*, Br., but the posterior metatarsus long and biserially spined beneath, its pulvillus apical; remaining tarsal joints unarmed beneath, their pulvilli occupying the entire joints. Tegminal rudiments present. In all but one species the posterior angles of the distal abdominal tergites strongly produced backwards. Supra-anal lamina (σ) quadrate.

Type of the genus—*C. nitida*, Br.

Stål founded the genus on *C. tartarea*, Stål, which is synonymous with *C. nitida*, Br. The genus is a link

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between the *Polyzosteria*-group and the *Blatta*-group, on account of the tarsal structure (Pl. IX, fig. 40b).

KEY TO THE SPECIES.

1. Piceous or castaneous.
 2. Piceous. Legs piceous. Broad convex species *C. nitida*, Br.
 - 2'. Castaneous. Legs testaceous. Narrow, sub-depressed species *C. melanesiae*, sp. n.
- 1'. Testaceous or ferruginous.
 2. Disc of pronotum with three fuscous markings arranged in a triangle *C. triangulata*, Br.
 - 2'. Pronotum with more or less distinct fuscous lateral vittae.
 3. Species exceeding 13 mm. in length.
 4. Posterior angles of distal abdominal tergites (♂) produced *C. heydeniana*, Sauss.
 - 4'. Posterior angles of distal abdominal tergites (♂) not produced *C. sedilloti*, Bol.
 - 3'. Species not exceeding 13 mm. in length *C. brunni*, Alf.

1. *C. nitida*, Br.

Polyzosteria nitida, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 214 (1865).

Periplaneta polita, Walker, Cat. Blatt. Brit. Mus., p. 139 (1868).

Cutilia tartarea, Stål, Oefv. Vet. Akad. Förh., xxxiv (10), p. 36 (1877).

? *Blatta aterrima*, Escholtz, Entomographien, p. 89 (1822).

This species, which is very variable in size, has a wide range outside Australia; the record of its occurrence in Australia is doubtful. I do not know whether Escholtz's type is preserved and his species may not perhaps have the slightest affinity with *nitida*, for the description is too brief for it to be possible to judge of that.

FORMOSA (British Mus., type of *polita*); PHILIPPINES (Stockholm Mus., type of *tartarea*; British Mus.); BORNEO (Oxford Mus.; Paris Mus.); TERNATE (British Mus.); AMBOINA (Vienna Mus., type of *nitida*; Oxford Mus.); NEW GUINEA (Oxford Mus.; Brussels Mus.; Melbourne Mus.);

TORRES STRAITS (British Mus.); NEW SOUTH WALES, Sydney (Oxford Mus.).

2. *C. melanesiæ*, sp. n.

♂ Above castaneous, nitid, impunctate. Head, legs and antennae bright testaceous. A broad castaneous stripe down the middle of the face. Tibial spines castaneous. Posterior borders of thoracic tergites slightly produced in the middle. Posterior angles of abdominal tergites moderately produced. Supra-anal lamina triangular, margins entire, apex truncate, fimbriate, scarcely emarginate, considerably exceeded by the cerci. Sub-genital lamina subquadrate, styles moderate, a well-marked spine at the base of each. Posterior metatarsus exceeding the succeeding joints in length.

Length 19 mm. ; pronotum 6 mm. × 8 mm.

TORRES STRAITS (British Mus., type).

Readily distinguished by the bright testaceous legs.

3. *C. triangulata*, Br.

Polyzosteria triangulata, Brunner von Wattenwyl, Ann. Mus. Civ. Genova, ser. 2a, xiii, p. 33 (1893).

Leptozosteria secunda, Tepper, Tr. R. Soc. S. Australia, xviii, p. 183 (1894).

Polyzosteria triangulata, Krauss, Denkschr. med.-nat. Ges. Jena, viii, p. 750, Pl. LXVII, fig. 1 (1903).

Stål in 1877 quotes this species as belonging to the genus *Cutilia* but gives no description of it. Brunner in a footnote (*l.c.*) alludes to the species but does not give a detailed diagnosis of it; if his remarks on the species beginning—"le metatarse un peu plus long que les autres articles réunis," etc. etc., are reckoned as a diagnosis then the name *triangulata* can stand, but if not then this name must be replaced by *secunda*, Tepp. This is a matter for priority-cranks to wrangle over, but it is not of the least importance. As Krauss gives a good description and figure of the species under the name *triangulata* and as this name is more appropriate than *secunda* I have no hesitation in adopting it.

QUEENSLAND, Rockhampton (Vienna Mus., type), Bowen (*Godoffroy*) (Stockholm Mus.), Cooktown (Adelaide Mus., type of *secunda*), Endeavour river (Oxford Mus.); THURSDAY Is. (Jena University Mus.).

4. *C. heydeniana*, Sauss.

Periplaneta heydeniana, Saussure, Rev. Zool. (2) xvi, p. 317 (1864).

Polyzosteria heydeniana, Saussure, Mém. Soc. Sci. Phys. Nat. Genève, xx, p. 256 (1869).

Periplaneta marginifera, Walker, Cat. Blatt. Brit. Mus., p. 144 (1868).

WEST AUSTRALIA, King George's Sound (British Mus., type of *marginifera*; Oxford Mus.; Geneva Mus., type of *heydeniana*; Paris Mus.), Albany (Hamburg Mus.).

5. *C. sedilloti*, Bol.

Polyzosteria sedilloti, Bolivar, Ann. Soc. Ent. France (6) ii, p. 459 (1882).

In the ♂ the posterior angles of the posterior abdominal tergites are rounded and they are not much produced in the ♀.

NEW ZEALAND (coll. Bolivar, type; Oxford Mus.).

6. *C. brunni*, Alfken.

Platyzozeria brunni, Alfken, Abh. Ver. Bremen, xvii, p. 142 (1901).

Known to me only from the description. It is apparently to be distinguished by its small size, but it must be noted that *sedilloti* itself varies considerably in size, a specimen in the Oxford Museum from the North island of New Zealand being smaller than specimens from the South island.

CHATHAM IS. (Bremen Mus., type).

Genus 6. ZONIOPLOCA, Stål.

Zonioploca, Stål, Bih. Svensk. Akad. ii (13), p. 13 (1874).

Knephasia, Tepper, Tr. R. Soc. S. Australia, xvii, p. 99 (1893).

Characters. Ocelli absent. Lateral margins of pronotum incassated. Dorsal surface granulate, or with shallow punctures. Tegminal rudiments absent. Posterior angles of abdominal tergites 5-7 strongly produced. Supra-anal lamina, (♂) quadrate, angles obtuse, lateral margins entire, (♀) triangular, apex emarginate. Sub-genital lamina (♂) trapezoidal, styles lateral. Posterior

metatarsus unarmed beneath, equal to the remaining joints in length, its pulvillus apical.

Type of the genus—*Z. alutacea*, Stål.

KEY TO SPECIES.

1. Dorsal surface granulate ; smaller species.
2. Tibiæ unicolorous, testaceous *Z. medilinea*, Tepp.
- 2'. Tibiæ castaneous on dorsal aspect,
testaceous on ventral aspect.
3. Pro- and mesonotum with lateral
fuscous vittae, abdomen above
transversely banded with fuscous
and olivaceous *Z. alutacea*, Stål.
- 3'. Pro- and mesonotum without lateral
fuscous vittae, abdomen above
unicolorous, testaceous *Z. pallida*, Shelf.
- 1'. Dorsal surface with large shallow punctures ; robust species.
2. Femora and tibiæ purple *Z. castii*, Tepp.
- 2'. Femora and tibiæ rufo-testaceous . . *Z. robusta*, sp. n.

1. *Z. medilinea*, Tepp.

Knephasia medilinea, Tepp., Tr. R. Soc. S. Australia, xvii, p. 100 (1893).

Readily distinguished by the dark median line, extending from the posterior border of the pronotum to near the apex of the abdomen.

VICTORIA, Lillimur ; SOUTH AUSTRALIA, Sedan, Northern territory (Adelaide Mus., types) ; WEST AUSTRALIA, Mt. Robinson (Hamburg Mus.; Oxford Mus.).

2. *Z. alutacea*, Stål.

Zonioploca alutacea, Stål, Bih. Svensk. Akad. ii (13), p. 13 (1874).

Platyzoisteria ardrossanensis, Tepp., Tr. R. Soc. S. Australia, xvii, p. 92 (1893).

Tepper's description of *ardrossanensis* corresponds perfectly with *alutacea*, the type of which has been kindly lent to me by Dr. Y. Sjöstedt of Stockholm.

"AUSTRALIA" (Stockholm Mus., type of *alutacea*) ; QUEENSLAND (Oxford Mus.) ; SOUTH AUSTRALIA, Ardrossan (Adelaide Mus., type of *ardrossanensis*) ; WEST AUSTRALIA, Albany (Deutsche Entom. National Museum).

3. *Z. pallida*, Shelf. (Plate IX, figs. 28a and 28b.)

Zonioploca pallida, Shelford, [*in*] Fauna Südwest Austral. ii, Lief. 9, Blattidae, p. 138, Pl. XIII, fig. 7 (1909).

This species varies considerably in size, in the extent of the granulation of the dorsal surface and some examples are paler than others.

WEST AUSTRALIA, various localities (Oxford Mus., types; Hamburg Mus.).

4. *Z. castii*, Tepp.

Anamesia castii, Tepper, Tr. R. Soc. S. Australia, xvii, p. 92 (1893).

Known to me only from the description.

CENTRAL AUSTRALIA (Adelaide Mus., type).

5. *Z. robusta* sp. n.

♀. Testaceous, nitid. Head castaneous, mouth-parts and antennae testaceous. Dorsum with large shallow punctures, thoracic tergites rugose laterally and with a lateral castaneous vitta, a castaneous spot at the base of the meso- and metanotum in the middle line. The punctures on the abdominal tergites rufo-castaneous; margins of 6th and 7th tergites very faintly serrate. Supra-anal lamina trigonal, sub-ecucullate, apex emarginate. Cerci not exceeding the lamina, slender, flattened. Abdomen beneath impunctate, pale testaceous, penultimate tergite and valves rufous. Legs rufo-testaceous.

Length 35 mm.; pronotum 10 mm. × 16.5 mm.

CENTRAL AUSTRALIA (*v. Leonhardi*), (Senckenberg Mus., type).

Genus 7. COSMOZOSTERIA, Stål.

Cosmozosteria, Stål, Bih. Svensk. Vet. Akad. ii (13), p. 13 (1874).

Characters. Ocelli present. Tegminal rudiments absent. Abdomen broader than thorax. Posterior angles of abdominal tergites 5-6 not, or scarcely produced, of tergite 7, produced. Angles of 9th abdominal tergite lobiform. Dorsal surface of abdomen scabrous. Supra-anal and sub-genital laminæ (♂) quadrate. Cerci short. Posterior metatarsus very short, unarmed beneath, its pulvillus occupying the greater part of the joint.

Type of the genus—*C. bicolor*, Sauss.

The genus is not very well marked off from *Platyzo-steria* but the species here included in it have all a well-marked facies which is quite distinct from that of *Platyzo-steria* species.

KEY TO THE SPECIES.

1. Unicolorous castaneous, except the angles of 9th abdominal tergite . . . *C. froggatti*, sp. n.
- 1'. Banded, margined or spotted with ochreous.
 2. Posterior margins of thoracic tergites ochreous.
 3. Abdominal tergites unicolorous . . . *C. zonata*, Walk.
 - 3'. Abdominal tergites spotted with ochreous.
 4. Meso- and metanotum not bordered laterally with ochreous *C. maculimarginata*, Tepp.
 - 4'. Meso- and metanotum bordered laterally with ochreous *C. bicolor*, Sauss. var.
 - 2'. Posterior margins of thoracic tergites not ochreous.
 3. Abdominal tergites with transverse ochreous streaks.
 4. Thoracic tergites with triangular lateral ochreous markings *C. gloriosa*, sp. n.
 - 4'. Thoracic tergites laterally banded with ochreous . . . *C. picta*, Tepp.
 - 3'. Abdominal tergites with small lateral ochreous spots.
 4. Thoracic tergites with complete lateral borders of ochreous *C. bicolor*, Sauss.
 - 4'. Thoracic tergites with incomplete lateral borders of ochreous *C. lateralis*, Walk.

1. *C. froggatti*, sp. n.

♂ and ♀. Uniform castaneous above, except the angles of the 9th abdominal tergite which are orange; margins of thoracic

tergites sometimes rather paler than the disc. Antennae rufescent. Thoracic tergites smooth, impunctate. Abdominal tergites rather scabrous. Supra-anal lamina, (♂) quadrangular, angles spiniform, deflexed, posterior margin straight, surpassed by sub-genital lamina which is quadrate, posteriorly widely emarginate, angles spiniform, with styles lateral, (♀) trigonal, sub-cucullate, apex rounded not emarginate, margins faintly crenulate. Cerci (mutilated in ♂) barely exceeding the supra-anal lamina (♀). Coxae margined with ochreous, posterior metatarsus short.

Length (♂) 25 mm., (♀) 27 mm.; pronotum 8 mm. × 12–13 mm.

QUEENSLAND, Lolworth (coll. Froggatt, type ♂), Peak Downs (Stockholm Mus., type ♀).

The ♀ ♀ are paler than the male.

2. *C. zonata*, Walk. (Pl. IX, figs. 31, 32.)

Polyzosteria zonata, Walker, Cat. Blatt. Brit. Mus., p. 159 (1868).

Polyzosteria quadrifascia, Walker, t. c., p. 160 (1868).

Polyzosteria pectoralis, Walker, t. c., p. 160 (1868).

Platyzozeria trifasciata, Tepper, Tr. R. Soc. S. Australia, xvii, p. 91 (1893).

Piceous (*quadrifascia*) or castaneous (*zonata*). Anterior margin of pronotum ochreous (*quadrifascia*) or unicolorous with disc (*trifasciata*); posterior margins of thoracic tergites narrowly or broadly (*zonata*) ochreous. Thoracic tergites minutely punctate with some smooth spaces. Dorsal surface of abdomen scabrous, posterior angles of 2nd to 5th tergites not produced, of 6th slightly produced, of 7th strongly produced, of 9th lobiform (♂) or spiniform (♀) and sometimes orange in colour. Lateral margins of 7th tergite serrate, more strongly in ♂ than in ♀. Abdomen beneath finely scabrous, lateral margins of 7th sternite (♂) denticulate, of 6th sternite (♀) serrate. Supra-anal lamina, (♂) quadrate, posteriorly non-emarginate and rufo-fimbriate, posterior angles produced as strong, deflexed spines, (♀) triangular, cucullate, apex emarginate, laterally serrate. Sub-genital lamina (♂) trapezoidal, posteriorly widely emarginate, exceeding the supra-anal lamina, posterior angles spinously produced, styles lateral. Cerci orange or piceous exceeding the supra-anal lamina (♂) but not the sub-genital lamina, acutely pointed. Coxae margined with testaceous.

Length (♂) 21 mm., (♀) 25.5 mm.; pronotum 6.5–7.5 mm. × 10–13.1 mm.

QUEENSLAND (British Mus., type of *quadrifascia*; Oxford Mus.; Melbourne Mus.); SOUTH AUSTRALIA, Northern territory (British Mus., type of *pectoralis*; Oxford Mus.; Adelaide Mus., type of *trifasciata*; Melbourne Mus.), Port Essington (British Mus., type of *zonata*; Oxford Mus.).

3. *C. maculimarginata*, Tepp.

Platyzosteria maculimarginata, Tepp., Tr. R. Soc. S. Australia, xix, p. 160 (1895).

Known to me only from the description; it may be only a varietal form of the preceding.

N. QUEENSLAND (Adelaide Mus., type).

4. *C. bicolor*, Sauss. (Pl. IX, fig. 33.)

Polyzosteria bicolor, Saussure, Rev. Zool. (2) xvi, p. 307 (1864); Mém. Soc. Sci. Phys. Nat. Genève, xx, p. 259 (1869).

Polyzosteria ligata, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 220 (1865).

Platyzosteria subzonata, Tepp., Tr. R. Soc. S. Australia, xviii, p. 181 (1894).

This is another species that in coloration is very variable; the form *subzonata* has the posterior margins of the thoracic tergites narrowly bordered with ochreous but is otherwise indistinguishable from the type form. Structurally the species differs from *C. zonata*, Walk., as follows:—The abdomen is less scabrous, none of the abdominal tergites or sternites are laterally serrate, the posterior angles of the 7th abdominal tergite are scarcely produced, the supra-anal lamina (♂) has minute, non-deflexed spines at the posterior angles, (♀) with the margins entire.

“AUSTRALIA” (Geneva Mus., type of *bicolor*); QUEENSLAND (Oxford Mus.), Port Curtis (Vienna Mus., type of *ligata*), Stradbroke Is. (coll. *Froggatt*); VICTORIA (Adelaide Mus., type of *subzonata*); NEW SOUTH WALES, Darling river (Oxford Mus.; Melbourne Mus.).

5. *C. gloriosa*, sp. n.

♀. Dark castaneous; thoracic tergites with large triangular flavid blotches situated near their posterior angles. Abdominal

tergites 1-7 with transverse narrow flavid streaks extending from the outer margins inward, 3 to 4 minute brown spots in each streak.

Dorsal surface minutely shagreened and with large punctures on the meso-, metanotum and abdominal tergites. Posterior angles of 6th abdominal tergite scarcely produced, of 7th strongly produced. (Cerci and supra-anal lamina mutilated.) Ventral surface castaneous, apex of valves and margins of coxae flavo-testaceous.

Length 25.2 mm.; pronotum 8.9 mm. \times 14 mm.

QUEENSLAND, Cooktown (Melbourne Mus., type).

The species is allied to *C. picta*, Tepp., but is I believe quite distinct.

6. *C. lateralis*, Walk.

Polyzosteria lateralis, Walker, Cat. Blatt. Brit. Mus., p. 154 (1868).

Polyzosteria ferruginea, Walker, t. c., p. 158 (1868).

♀. Rufo-castaneous, thoracic tergites minutely shagreened, abdomen above very scabrous. Pronotum on the antero-lateral margins only ochreous, meso- and metanotum with an ochreous spot at the anterior angles. Abdominal tergites 2-6 with small ochreous spots, laterally situated. Posterior angles of tergites 6-7 produced, of 9th tergite lobiform, ochreous. Supra-anal lamina trigonal, lateral margins serrate, apex not emarginate, exceeded by the cerci which are tipped with ochreous. Thoracic tergites beneath testaceous, outwardly margined with castaneous, abdominal sternites 1-6 with lateral ochreous spots. Coxae margined with testaceous.

Length 21 mm.; pronotum 7.2 mm. \times 12 mm.

Hab. "AUSTRALIA" (British Mus., types; Oxford Mus.).

7. *C. picta*, Tepp.

Platyzoisteria (?) *picta*, Tepp., Tr. R. Soc. S. Australia, xviii, p. 182 (1894).

Known to me only from the description.

QUEENSLAND, Cooktown (Adelaide Mus., type).

Genus 8. ANAMESIA, Tepp.

Anamesia, Tepp., Tr. R. Soc. S. Australia, xvii, p. 69 (1893).

Pseudolampra, Tepp., t. c., p. 96 (1893).

Characters. Ocelli present or absent. Pronotum with margins not reflexed nor incrassated. Tegminal rudiments absent. Dorsal surface of abdomen not scabrous, with shallow punctures. Posterior angles of none of the abdominal tergites produced, angles of 9th abdominal tergite often lobiform. Cerci short, flattened. Supra-anal lamina, (♂) quadrate, (♀) trigonal, sub-cucullate. Tibiae with spines on outer aspect tri-seriately arranged. Posterior metatarsus shorter than remaining joints, not spined beneath, its pulvillus occupying the greater part of the joint.

Type of the genus—*A. frenchii*, Tepp.

The foregoing description is drawn up after an examination of *A. frenchii*, Tepp., *A. polyzona*, Walk., a new form, and a larva of *Pseudolampra punctata*, Tepp. Mr. Froggatt at my request very kindly sent to Mr. Tepp an example identified by me as *A. frenchii*, and Mr. Tepp, having compared the specimen with his own type, pronounces them to be identical. *P. punctata*, Tepp., and *P. rottei*, Tepp., are undoubtedly congeneric with *frenchii* and it is not easy to understand why the genus *Pseudolampra* was ever erected. The most important character of *Anamesia* is the obtuse angulation of the 7th abdominal tergite; it is possible that all of the Tepparian species do not conform to this character, in which case they must be referred to other genera. The following key is quite provisional and too much reliance must not be placed on it.

KEY TO THE SPECIES.

1. Not unicolorous but banded or margined with paler colour.
 2. Posterior margins of abdominal tergites ochreous.
 3. Posterior margins of thoracic tergites ochreous *A. polyzona*, Walk.
 - 3'. Posterior margins of thoracic tergites not ochreous *A. lambii*, Tepp.
 - 2'. Posterior margins of abdominal tergites not ochreous.
 3. Abdomen bordered laterally with ochreous *A. frenchii*, Tepp.
 - 3'. Abdomen not bordered laterally with ochreous *A. lindsayi*, Tepp.
- 1'. More or less unicolorous.
 2. Pronotum unicolorous testaceous *A. walkeri*, sp. n.
 - 2'. Pronotum with fuscous maculae.

3. Rufo-castaneous beneath *A. punctata*, Tepp.
 3'. Piceous beneath *A. rottei*, Tepp.
 Species of uncertain position $\left\{ \begin{array}{l} A. circumcincta, \text{Walk.} \\ A. fulvornata, \text{Tepp.} \\ A. ornata, \text{Tepp.} \end{array} \right.$

1. *A. polyzona*, Walk. (Pl. IX, figs. 34, 35.)

Polyzosteria polyzona, Walker, Cat. Blatt. Brit. Mus., p. 159 (1868).

Anamesia polyzona, Shelford, [in] Fauna Südwest Austral., ii, Lief. 9, Blattidae, Pl. XIII, f. 10 (1909).

♂. Rufo-castaneous, nitid, impunctate, terminal tergites with shallow punctures and wrinkles. Head rufous, antennae testaceous, ocelli indistinct. Pronotum bordered all round with ochreous, meso- and metanotum and abdominal tergites 1-7 laterally and posteriorly bordered with ochreous. Angles of 9th abdominal tergite lobiform. Supra-anal lamina quadrate, castaneous at base, apex ochreous, margins entire, apex truncate, fimbriate, surpassed by the sub-genital lamina which is quadrate, produced, posteriorly not emarginate, with the styles lateral. Cerci short and flattened, exceeding the supra-anal but not the sub-genital lamina. Abdominal sternites posteriorly narrowly margined with flavo-testaceous. Legs flavo-testaceous, spines castaneous.

♀. Similar to ♂ but head and legs rufo-castaneous, antennae rufescent. Angles of 9th abdominal tergite more lobiform. Supra-anal lamina trigonal, margins serrate, not exceeded by the cerci.

Length (♂) 29 mm., (♀) 32 mm.; pronotum (♂) 8 mm. × 14 mm., (♀) 10 mm. × 18 mm.

WEST AUSTRALIA, Swan River (British Mus., type), Dirk Hartog, Evadu, Fremantle (*Michaelsen* and *Hartmeyer*), (Hamburg Mus.; Oxford Mus.).

2. *A. lambii*, Tepp.

Anamesia lambii, Tepp., Tr. R. Soc. S. Australia, xvii, p. 70 (1893).

Known to me only by the description.

CENTRAL AUSTRALIA, Innaminka (Adelaide Mus., type).

3. *A. frenchii*, Tepp.

Anamesia frenchii, Tepp., t. c., p. 72 (1893).

The supra-anal lamina of the male is quadrate with truncate, non-emarginate, fimbriate apex, the lateral

margins are minutely serrate; in the female the lamina is constructed as in *polyzona* ♀. The species varies in colour; in some examples the pale border is broad and the legs are testaceous, in others the pale border is narrow and the legs are castaneous.

NORTH QUEENSLAND (Adelaide Mus., type); WEST AUSTRALIA, Day Dawn (*Michaelsen* and *Hartmeyer*), (Hamburg Mus.), Lawlers (coll. *Froggatt*).

4. *A. lindsayi*, Tepp.

Anamesia lindsayi, *Tepper*, t. c., p. 71 (1893).

Known to me only from the description.

WEST AUSTRALIA, Fraser range (Adelaide Mus., type).

5. *A. walkeri*, sp. n.

♂. Unicolorous testaceous. Head, dorsal surface and abdominal sternites finely punctate. Eyes very wide apart, equally distant with the antennal sockets. Supra-anal lamina quadrate, margins entire, apex truncate, non-emarginate, fimbriate, surpassed by the subgenital lamina which is quadrate, produced, posteriorly very slightly emarginate, with styles from near the base. Cerci short, blunt, exceeding both laminae.

Length 21.2 mm.; pronotum 7.1 mm. × 11 mm.

NEW S. WALES, Sydney (Oxford Mus., type).

This is a somewhat remarkable species, superficially resembling very closely *Zonioploca pallida* mihi, but distinguished by the non-incrassated margins of the pronotum, non-produced angles of the abdominal tergites, absence of granules on the dorsal surface and by the unicolorous legs. The distance of the eyes apart shows that much reliance cannot be placed on this character for purposes of discriminating between Old and New World Blattinae. I have much pleasure in naming this interesting species after my friend and colleague, Commander J. J. Walker, R.N., who presented the unique example to the Oxford Museum.

6. *A. punctata*, Tepp.

Pseudolampra punctata, *Tepper*, Tr. R. Soc. S. Australia, xvii, p. 97 (1893).

WEST AUSTRALIA, Fraser range (Adelaide Mus., type); SOUTH AUSTRALIA, Tennant's Creek (Deutsche Ent. Nat. Mus.).

7. *A. rothci*, Tepp.

Pseudolampra rothci, Tepp., t. c., p. 98 (1893).

SOUTH AUSTRALIA, Sedan (Adelaide Mus., type).

8. ? *A. ornata*, Tepp.

Pseudolampra ornata, Tepp., t. c., p. 98 (1893).

SOUTH AUSTRALIA (Adelaide Mus., type).

9. ? *A. circumcincta*, Walk.

Polyzosteria circumcincta, Walker, Cat. Derm. Salt. Brit. Mus. V. Suppl. Blatt., p. 36 (1871).

A young larva, possibly of *A. frenchii*.

AUSTRALIA (British Mus., type).

10. ? *A. fulvornata*, Tepp.

Anamesia (?) *fulvornata*, Tepp., Tr. R. Soc. S. Australia, xviii, p. 177 (1894).

Mr. Tepp. himself is doubtful of the systematic position of this species.

VICTORIA, Howbullan (Adelaide Mus., type).

Genus 9. DESMOZOSTERIA, Shelf.

Desmozosteria, Shelford, [*in*] Fauna Südwest Austral., ii, Lief. 9, Blattidae, p. 139 (1909).

Characters. Allied to *Zonioploca*, but the angles of none of the abdominal tergites backwardly produced. Lateral margins of the pronotum incrassated. Tegminal rudiments absent. Dorsal surface punctate or smooth. Supra-anal lamina (♂) quadrate, margins entire, (♀) trigonal, cucullate. Cerci short, flattened. Posterior metatarsus very short, not spined beneath.

Type of the genus *D. michaelsoni*, Shelf.

The genus stands in the same relation to *Zonioploca* that *Anamesia* does to *Cosmozosteria*.

KEY TO THE SPECIES.

1. Thoracic tergites uniformly punctate . . . *D. grosse-punctata*, sp. n.
- 1'. Thoracic tergites not uniformly punctate, or smooth.
2. Thoracic tergites smooth *D. michaelsoni*, Shelf.
- 2'. Thoracic tergites laterally finely punctate.
3. Castaneous banded with ochreous . . . *D. cincta*, sp. n.
- 3'. Rufescent *D. rufescens*, Shelf.

1. *D. grosse-punctata*, sp. n.

♀. Above piceous; lateral and posterior margins of all the tergites, anterior margin of pronotum, bright ochreous. Thoracic tergites deeply and closely punctate, abdominal tergites smooth. Beneath uniformly flavo-testaceous. Vertex, antennae except the basal joints, maxillary palpi, upper border of femora, the tibiae and tarsi, piceous. Anterior and lateral margins of pronotum, lateral margins of meso- and metanotum strongly incrassated, the posterior angles strongly produced backwards. Supra-anal lamina faintly scabrous, trigonal, margins entire, apex not emarginate, not exceeded by the cerci which are ochreous above and castaneous below.

Length 23.5 mm.; pronotum 7.3 mm. \times 10.1 mm.

Habitat unknown (Oxford Mus., type).

A very distinct species, undoubtedly Australian in origin.

2. *D. michaelseni*, Shelf.

Desmozosteria michaelseni, Shelford, op. cit., p. 139, Pl. XIII, fig. 9 (1909).

WEST AUSTRALIA, Boorabbin (*Michaelsen* and *Hartmeyer*), (Hamburg Mus., type).

3. *D. cincta*, sp. n.

♀. Above nitid, castaneous, posterior margins of all the tergites and the lateral margins of the thoracic tergites ochreous; beneath sordid testaceous. Occiput and vertex of head castaneous; antennae with basal joint castaneous, remainder piceous, maxillary palpi piceous. Lateral margins of thoracic tergites strongly incrassated, discs finely punctate, posterior margins convex. Supra-anal lamina sub-quadrate, angles rounded, non-emarginate, barely exceeded by the cerci which are testaceous. Femora and tibiae rufo-castaneous on the dorsal aspect, testaceous on the ventral aspect.

Length 26.6 mm.; pronotum 8.4 mm. \times 12 mm.

CENTRAL AUSTRALIA (*v. Leonhardi*), (Senckenberg Mus., type).

Superficially the insect closely resembles *Anamesia polyzona*, Walk.

4. *D. rufescens*, Shelf.

Desmozosteria rufescens, Shelford, op. cit., p. 140 (1909).

WEST AUSTRALIA, Denham (*Michaelsen* and *Hartmeyer*), (Hamburg Mus., type; Oxford Mus.).

Genus 10. TEMNELYTRA, Tepp.

Temnelytra, Tepp., Tr. R. Soc. S. Australia, xvii, p. 38 (1893).

Characters. Body flattened and depressed. Antennae longer than the body. Pronotum anteriorly parabolic, posteriorly truncate, exposing the large scutellum. Tegmina quadrate or sub-quadrate, extending to the 1st abdominal tergite. Wings entirely absent. 1st abdominal tergite (♂) with scent-gland opening. Posterior angles of distal abdominal tergites produced (*T. undulivitta*, Walk., ♂ is an exception). Supra-anal lamina, (♂) quadrate, margins entire, (♀) triangular, apex emarginate. Cerci longer than the lamina in both sexes. Posterior metatarsus very short, spined beneath.

Type of the genus—*T. truncata*, Br.

This is a well-defined genus. The obtuse angles of the distal abdominal tergites in *T. undulivitta*, Walk. (†), is paralleled in the genus *Catilia* by *C. sedilloti*, Bol. (†), also a New Zealand species. The species *abbreviata* included by Mr. Tepp. in this genus is a true species of *Temnopteryx* (sub. fam. *Phyllodromiinae*); I have seen the type, which is in the Melbourne Museum.

KEY TO THE SPECIES.

1. Pronotum with fuscous vittæ . . . *T. undulivitta*, Walk.
- 1'. Pronotum without fuscous vittæ.
2. Tegmina quadrate *T. truncata*, Br.
- 2'. Tegmina with outer angles hebetate *T. subtruncata*, Tepp.

1. *T. undulivitta*, Walk. (Pl. IX, fig. 36.)

Periplaneta undulivitta, Walker, Cat. Blatt. Brit. Mus., p. 144 (1868).

♂. Rufo-testaceous. A band between the eyes and two stripes down the face, castaneous. Antennae rufo-testaceous. Pronotum with the disc rather darker than the margins, an undulate castaneous vitta on each side, extending on to the tegmina, which are quadrate, their venation obsolete. Abdomen fusco-castaneous, margins and two spots on each side rufo-testaceous. Posterior angles of abdominal tergite not backwardly produced. Supra-anal lamina quadrate, posterior angles acute, posteriorly widely emarginate. Cerci very short and blunt. Sub-genital lamina quadrate, styles as long as cerci, lateral. Legs testaceous.

♀. Similar, abdomen above testaceous with lateral castaneous spots

on tergites 2-5, tergites 6 and 7 castaneous. Supra-anal lamina triangular, apex emarginate, castaneous at base, rest testaceous. Posterior angles of abdominal tergites backwardly produced. Cerci longer and more acuminate.

Length (♂) 15 mm., (♀) 14 mm.; tegmina, (♂) 4 mm., (♀) 3.5 mm.; pronotum 5 mm. × 6 mm.

NEW ZEALAND (British Mus., type; Vienna Mus.).

2. *T. truncata*, Br. (Pl. IX, figs. 37a and 37b.)

Polyzosteria truncata, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 217 (1865).

Temnelytra harpuri, Tepper, Tr. R. Soc. S. Australia, xvii, p. 39 (1893).

I have seen specimens in the Melbourne Museum identified by Mr. Tepper, and there can be no doubt of the specific identity of *truncata* and *harpuri*.

NEW SOUTH WALES (Vienna Mus., type of *truncata*), Goulburn Range (Melbourne Mus.); VICTORIA, Gippsland (Melbourne Mus.; Oxford Mus.); SOUTH AUSTRALIA, Kangaroo Is. (Adelaide Mus., type of *harpuri*).

3. *T. subtruncata*, Tepp.

Temnelytra subtruncata, Tepper, op. cit., xix, p. 164 (1895).

Distinguished by the darker colour and by the form of the tegmina, which are shorter in the ♀ than in the ♂, scarcely extending beyond the middle of the metanotum.

VICTORIA, Fernshaw (Melbourne Mus., types; Oxford Mus.).

Genus 11. SCABINA, nov.

Characters. Eyes and antennal sockets equally far apart. Ocelli present. Antennae robust. Pronotum parabolic, posteriorly truncate, exposing the scutellum. Tegmina quadrate, corneous, not extending beyond the 1st abdominal tergite. Wings rudimentary, squamiform. Posterior angles of abdominal tergites strongly produced backwards. Supra-anal lamina (♂) quadrate, entire. Cerci exceeding the lamina. Styles long, slender. Posterior metatarsus shorter than succeeding joint, not spined beneath, its pulvillus apical.

Type of the genus—*S. antipoda*, Kirby.

The genus is very close to *Eurycotis* and *Pelmatosilpha* of
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the New World, but all the species of those genera that I have been able to examine have the posterior metatarsus spined beneath.

1. *S. antipoda*, Kirby.

Pelmatosilpha (?) *antipoda*, Kirby, Ann. Mag. Nat. Hist., ser. 7, xii, p. 376 (1903).

To Kirby's description may be added:—

Tegmina with outer margins incrassate and sinuate. Wings squamiform, scarcely exceeding the metanotum. Supra-anal lamina with non-serrate margins, apex non-emarginate. Styles not lateral in position.

Length 25 mm. ; tegmina 7.5 mm. ; pronotum 8.9 mm. × 12 mm.

QUEENSLAND (British Mus., type ; Oxford Mus., co-type).

Genus 12. METHANA, Stål.

Methana, Stål, Oefv. Vet. Akad. Förh. xxxiv (10), p. 36 (1877).

Wodongia, Tepper, Tr. R. Soc. S. Australia, xix, p. 155 (1895).

Characters. Antennae longer than body. Pronotum anteriorly parabolic, almost covering vertex of head, posteriorly very obtusely angled. Scutellum not exposed. Tegmina and wings fully developed, at least as long as the abdomen, generally longer. Supra-anal lamina (♂) quadrate, margins not serrate, (♀) triangular, apex emarginate. Cerci long, acuminate. Femora heavily spined. Posterior metatarsus about equal in length to remaining joints, biserially spined beneath, its pulvillus apical ; remaining joints of tarsus with large pulvilli, not spined beneath.

Type of the genus : *M. marginalis*, Sauss.

KEY TO THE SPECIES.

1. Uniform castaneous.
 2. Large species, exceeding 30 mm. in total length *M. magna*, sp. n.
 - 2'. Smaller species, less than 30 mm. in total length *M. convexa*, Walk.
- 1'. Not uniform castaneous.
 2. Pronotum testaceous with fuscous vittae. *M. curviger*a, Walk.
 - 2'. Pronotum castaneous with flavo-testaceous margins.

3. Posterior margin of pronotum not bordered with flavo-testaceous.
4. Disc of pronotum immaculate . . . *M. marginalis*, Sauss.
- 4'. Disc of pronotum with two ochraceous maculae *M. soror*, Sauss.
- 3'. Posterior margin of pronotum bordered with flavo-testaceous.
4. Tegmina laterally margined with flavo-testaceous *M. papua*, Shelf.
- 4'. Tegmina uniform castaneous . . . *M. hosei*, sp. n.
- Species of doubtful position *M. pallipalpis*, Serv.

1. *M. magna*, sp. n.

♂ and ♀. Castaneous, nitid. Head sordid testaceous, vertex, a band between the antennal sockets, a W-shaped band at base of clypeus, castaneous. Antennae with basal joint testaceous, remainder castaneous. Pronotum with sides deflexed, posteriorly truncate. Tegmina and wings exceeding apex of abdomen. Supra-anal lamina (♂) quadrate, fimbriate, margins entire, (♀) triangular, apex widely emarginate. Cerci very long, acuminate. Genital styles (♂) very long and slender. Coxae and front legs testaceous, mid femora rufo-testaceous with castaneous lines, mid-tibiae and tarsi and hind legs castaneous. Posterior metatarsus a trifle shorter than remaining joints, its pulvillus large.

♂ and ♀. Total length 40-41 mm. ; length of body, 34-35 mm. ; of tegmina, 30-31 mm. ; pronotum 10.5 mm. × 15 mm.

BORNEO, Sarawak (*Shelford*) (Oxford Mus., ♂ and ♀ types).

The species bears a close superficial resemblance to *Periplaneta valida*, Br., the type of which I have seen, but can readily be distinguished by the structure of the tarsi.

2. *M. convexa*, Walk.

Periplaneta convexa, Walker, Cat. Derm. Salt. Brit. Mus., Suppl. Blatt., p. 152 (1869).

Methana rufescens, Kirby, Ann. Mag. Nat. Hist., ser. 7, xii, p. 374 (1903).

♂. Rufo-castaneous, nitid. Head rufo-castaneous or piceous ; mouth-parts testaceous. Tegmina and wings not extending much beyond the apex of the abdomen. Supra-anal lamina produced, quadrate, margins entire, apex not emarginate. Sub-genital lamina

trapezoidal, styles very long and slender. Cerci long and acuminate. Legs rufo-castaneous.

Total length 23-24.5 mm.; length of body 19-21 mm.; length of tegmina, 16.5-19 mm.; pronotum 7 mm. \times 9 mm.

QUEENSLAND, Moreton Bay (British Mus., type of *convexa*); NEW SOUTH WALES, Sydney, Home Bush (*W. W. Froggatt*), (British Mus., type of *rufescens*; Oxford Mus.).

I have compared the types and found them identical. Kirby gives the species identified by Brunner as *pallipalpis*, Serv., as a synonym of *rufescens*, but in Brunner's species the supra-anal lamina (σ) is described as "profondément découpée," whereas in *rufescens* this is not the case; this is too important a character to be ignored.

3. *M. curviger*a, Walk.

*Periplaneta curviger*a, Walker, Cat. Blatt. Brit. Mus., p. 134 (1868).

QUEENSLAND, Moreton Bay (British Mus., type).

4. *M. marginalis*, Sauss.

Periplaneta marginalis, Saussure, Rev. Zool. (2), xvi, p. 319 (1864).

Periplaneta ligata, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 234 (1865).

"AUSTRALIA" (Paris Mus., type of *marginalis*); QUEENSLAND, Port Curtis (Vienna Mus., type of *ligata*); NEW SOUTH WALES, Hunter River (Oxford Mus.).

5. *M. soror*, Sauss.

Periplaneta soror, Saussure, Rev. Zool. (2), xvi, p. 319 (1864),

Periplaneta biquadrata, Walker, Cat. Blatt. Brit. Mus., p. 134 (1868).

Periplaneta oculata, Walker, Cat. Derm. Salt. Brit. Mus., Suppl. Blatt., p. 152 (1869).

Wodongia lunata, Tepper, Tr. R. Soc. S. Australia, xix, p. 155 (1895).

This differs from the preceding species by the greater distance apart of the eyes, the immaculate head and the pale legs. The colouring of the pronotum varies a good

deal, sometimes the two maculae on the disc becoming confluent as in *lunata*.

"AUSTRALIA" (Paris Mus., type of *soror*; British Mus., type of *biquadrata*; Oxford Mus., type of *oculata*); VICTORIA, Wodonga (Melbourne Mus., type of *lunata*).

6. *M. papua*, Shelf.

Methana papua, Shelford, Mém. Soc. ent. Belg., xv, p. 234 (1908).

BRITISH NEW GUINEA, Astrolabe District (Genoa Mus., ♂ type; Brussels Mus., ♀ type).

7. *M. hosei*, sp. n.

♀. Head, body and legs piceous, front coxae and a large blotch on the posterior coxae testaceous. Pronotum sub-quadrate, sides strongly deflexed, bordered all round with ochreous, the border being very broad on the postero-lateral and posterior margins, its inner margin sinuate. Tegmina and wings uniform castaneous, extending considerably beyond the apex of the abdomen. Supra-anal lamina triangular, cucullate, apex triangularly emarginate. Cerci moderate.

Total length 29 mm.; length of body 24 mm.; length of tegmina 23 mm.; pronotum 7.9 mm. × 9 mm.

BORNEO, Sarawak, Baram District (*C. Hose*), (Oxford Mus., type).

8. ? *M. pallipalpis*, Serv.

Kakerlac pallipalpis, Serville, Hist. Nat. Ins. Orth., p. 71 (1839).

? *Periplaneta pallipalpis*, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 238 (1865).

As the type of this species is lost, its systematic position is quite uncertain. Brunner states (Ann. Mus. Civ. Genova, ser. 2a xiii, p. 36 (1893) that the species as identified by him belongs to the genus *Methana*.

JAVA; SUMATRA (*de Haan*); AUSTRALIA (*Brunner*).

Genus 13. PARAMETHANA, Shelf.

Paramethana, Shelford, Sjöstedt's Kilimandjaro-Meru Exp., Blattodea, p. 31 (1907).

Characters.—Differs from *Methana* in the short tegmina and wings which do not extend beyond the fifth abdominal tergite and

in the discoidal pronotum. Third antennal joint nearly three times longer than the second.

Type of the genus—*P. robusta*, Shelf.

P. robusta, Shelf.

Paramethana robusta, Shelford, *l. c.*, p. 31, Pl. II, fig. 7 (1907).

GERMAN EAST AFRICA, Lower Meru (Stockholm Mus., type; Oxford Mus.).

XI. REVISION OF THE GENUS *Gyna*, BR., WITH A DESCRIPTION OF A NEW GENUS.

The genus *Gyna* was formed in 1865 (Brunner, *Nouv. Syst. Blatt.*, p. 266) for the reception of some species of African *Blattidae* that previously had been placed in *Panchlora*; since that date a number of species have been added by various authors, and as many of the species are closely allied, cryptically coloured forms, presenting few salient features of taxonomic importance, their identification has been attended with considerable difficulty. Fortunately I have been able to examine and compare nearly all the types, and my grateful thanks are due to Dr. H. Dohrn of Stettin, Dr. Y. Sjöstedt of Stockholm, Dr. F. Römer of Frankfort-à-M., Dr. K. Holdhaus of Vienna, Dr. Giglio-Tos of Cagliari and Dr. M. Bedot of Geneva for the loan of the valuable specimens in their charge; without this friendly co-operation a satisfactory revision of the genus was out of the question. I have received for determination large collections of African *Blattidae* from various continental Museums, and as all—but especially the West African collections—are very rich in examples of this particular genus I am confident that I have in my possession at present a greater amount of material for the revision of the genus than has ever before been gathered together. The tropics of West Africa may be regarded as the head-quarters of the genus, for no less than 18 out of the 23 known species occur there; there are 4 East African and only 2 South African species. In my account of the *Blattidae* collected by Dr. Y. Sjöstedt on his Kilimandjaro-Meru expedition I gave my reasons for believing that the genera *Trichomera*, Kirby, and *Apotrogyia*, Kirby, were based on larval forms of *Gyna* and I still see no reason to modify that

opinion. The West-African collections before me contain quantities of examples that could be referred equally well to either of Mr. Kirby's genera but I have never yet seen an adult example that could be referred to them. The erect pubescence of *Trichomera insignata* persists in many species of *Gyna*, and the structural differences between *Trichomera* and *Apotrogia* on the one hand and *Gyna* on the other are such as we are thoroughly familiar with in the larvae and adults of other genera of Blattidae.

The species of *Gyna* can be divided into two sections; in one section the pronotum is smooth and nitid, rich castaneous in colour, with ochreous margins; in the other section the pronotum is testaceous but the disc is occupied with a piceous or castaneous lyrate marking that under the lens presents an appearance as if it had been chiselled out of the surface of the pronotum; the form and extent of the marking is very variable and presents few characters of importance in classifying the species. *G. hyalina* may be regarded as intermediate in character between the two sections of the genus and *G. capucina* in its pronotal colour and sculpture occupies an isolated position. The distance apart of the eyes on the vertex in the male is a character of some importance and full use has been made of it in the following synoptical key. Another character that can be employed, though with caution, to separate species with lyrate markings on the pronotum, is the presence or absence of a circular rufescent macula on the discoidal field of the tegmina. The posterior part of the pronotum and the tegmina in some species (e. g. *G. maculipennis* and *G. fervida*) present a peculiar mottled appearance, which is due to the irregular deposition of opaque testaceous pigment between the two layers of chitin, the chitin itself being quite transparent. De Bormans (Ann. Soc. ent. Belg., xxv, p. 21, 1881) figures the ootheca of *G. caffrorum*; from his figure and description I believe that the ootheca is merely a membranous sac and that the species of this genus are viviparous or ovo-viviparous like the Epilamprinae whose place in Africa is so largely taken by the species of *Gyna*. Karny (Jenaische Denkschriften, xiii, p. 382, 1908) has suggested that the ulnar rami of the wings in a species described by him as *Gyna stridulans* have the power of producing a rattling noise when the insect flies. He sees a resemblance between this part of the wing in the cock-

roach and the anterior field of the wings of certain Acrididae and Locustidae which he has proved to produce a rattling noise during flight with the wings alone, neither the legs nor the tegmina taking any part in the operation (Stett. Ent. Zeit. 1908, pp. 112-119). This rattling or rustling noise is of course to be distinguished from the true stridulation produced by insects at rest. The wing-structure of *Gyna stridulans* (= *caffrorum*, Stål) is by no means exceptional, for not only have the other species of the genus a similar wing-venation but other genera present similar features; it would be interesting to learn from observations in the field if any Blattidae produce a rattling noise when flying.

Genus GYNA, Br.

Gyna, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 266 (1865).

Trichomera, Kirby, Ann. Mag. Nat. Hist., ser. 6, xviii p. 257 (1896).

Apctrogia, Kirby, op. cit., ser. 7, v, p. 281 (1900).

KEY TO THE SPECIES.

1. Pronotum with anterior half castaneous, posterior half ochreous . . . *G. capucina*, Gerst.
- 1'. Pronotum not as above.
2. Pronotum with disc castaneous, margins flavo-testaceous or ochreous.
3. Tegmina flavo-marginate throughout the greater part of their length.
4. Eyes (♂) touching or nearly touching on vertex of head.
5. Larger (19-20 mm. in total length) *G. scutelligera*, Walk.
- 5'. Smaller (15 mm. in total length) *G. costalis*, Walk.
- 4'. Eyes (♂) wide apart . . . *G. castanea*, sp. n.
- 3'. Tegmina not flavo-marginate throughout the greater part of their length.
4. Tegmina castaneous with 4 ochreous maculae . . . *G. gloriosa*, Stål.

- 4'. Tegmina with basal two-fifths castaneous, remainder testaceous . . . *G. jocosa*, Shelf.
- 2'. Pronotum testaceous or flavo-testaceous with lyrate chiselled markings on the disc.
3. Lyrate markings on disc of pronotum obsolescent. (Bright flavous species) . . . *G. laticosta*, Walk.
- 3'. Lyrate markings on disc of pronotum not obsolescent.
4. Small species (not exceeding 22 mm.).
5. Eyes nearly touching on vertex of head . . . *G. oblonga*, Borg.
- 5'. Eyes not nearly touching on vertex of head.
6. Frons strongly striate . . . *G. nigrifrons*, Bol.
- 6'. Frons not strongly striate *G. peringueyi*, sp. n.
- 4'. Larger species.
5. Antennae bifasciated with ochreous.
6. Mediastinal field of tegmina opaque testaceous *G. centurio*, Dohrn.
- 6'. Mediastinal field concolorous with rest of tegmina *G. sculpturata*, sp. n.
- 5'. Antennae not bifasciated with ochreous.
- ♂ ♂
6. Eyes touching or nearly touching on vertex of head.
7. Tegmina with rufescent macula in centre of disc.
8. Antennae rufo-fuscous or fuscous . . . *G. actola*, sp. n.
- 8'. Antennae piceous, nitid.
9. Distance apart of eyes on vertex

- of head greater
than thickness
of 1st antennal
joint.
10. Larger species
(30 mm. in
length). . . *G. maculipennis*, Schaum.
- 10'. Smaller
species (22-
24 mm. in
length). . . *G. kazungulana*, Gig.-Tos.
- 9'. Distance apart
of eyes on vertex
of head less than
thickness of 1st
antennal joint . . . *G. lurida*, Sauss.
- 7'. Tegmina immaculate. *G. incommoda*, sp. n.
- 6'. Eyes wide apart on
vertex of head.
7. Smaller species (20
mm. in length) . . .
8. Tegmina with rufes-
cent macula on
disc *G. fervida*, Sauss.
- 8'. Tegmina without
rufescent macula
on disc *G. aestuans*, Sauss.
- 7'. Larger species (30
mm. in length).
8. Tegmina with rufes-
cent macula on
disc *G. cafferorum*, Stål.
- 8'. Tegmina without
rufescent macula
on disc *G. aurivillii*, Borg.
- ♀ ♀
6. Eyes close together on
vertex of head . . . *G. hyalina*, sp. n.
- 6'. Eyes wide apart on
vertex of head.
7. Tegmina without rufes-
cent macula on disc.
8. Lyrate markings of
pronotum not
fused *G. incommoda*, sp. n.

- 8'. Lyrate markings of pronotum fused . *G. aurivillii*, Borg.
- 7. Tegmina with rufescent macula on disc.
- 8. Supra-anal lamina short, rounded . *G. lurida*, Sauss.
- 8'. Supra-anal lamina produced, subquadrate, subbilobate.
- 9. Antennæ rufous fuscous or fuscous. Distance apart of eyes equals length of 1st antennal joint.
- 10. Rufescent macula on disc of tegmina large. *G. fervida*, Sauss.
- 10'. Rufescent macula on disc of tegmina small, occasionally absent . . *G. aetola*, sp. n.
- 9'. Antennæ piceous, nitid. Distance apart of eyes greater than length of 1st antennal joint.
- 10. Anterior part of wings heavily suffused with a dark castaneous . . *G. cafferorum*, Stål.
- 10'. Anterior part of wings not as above . *G. maculipennis*, Schaum
- Doubtful species *G. colini*, Rochebr.

1. *G. capucina*, Gerst.

Gyna capucina, Gerstaecker, Mitt. Ver. Neuropomm. u. Rugen, xiv, p. 72 (1883).

Gyna maculipennis, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 268, Pl. VI, fig. 30 (1865).

A common and well-marked species that occurs in most collections from West Africa. There is a variety with the pronotum anteriorly margined with ochreous.

KAMERUN (Greifswald Mus., type; Oxford Mus.; Berlin Mus.; Vienna Mus.): FERNANDO PO (Genoa Mus.); FRENCH CONGO (Genoa Mus.).

2. *G. scutelligera*, Walk.

Panchlora scutelligera, Walker, Cat. Blatt. Brit. Mus., p. 32 (1868).

♂. Head testaceous with frons castaneous; antennae fuscous. Eyes almost touching on vertex. Pronotum with the disc castaneous, broadly margined all round with flavo-testaceous. Tegmina castaneous, outwardly margined almost to apex with flavo-testaceous. Wings suffused with rufo-castaneous, ulnar vein with 10 rami, 7 being incomplete. Abdomen rufo-testaceous, supra-anal lamina sub-quadrate, apex not emarginate, exceeded by the sub-genital lamina which is small and furnished with 2 styles. Cerci moderate. Legs rufo-testaceous.

Total length 19.5 mm.; length of body 15 mm.; length of tegmina 17 mm.; pronotum 6.3 mm. × 7.5 mm.

GAMBIA (British Mus., type); PORTUGUESE GUINEA, Bolama (*L. Fca*), (Genoa Mus.).

3. *G. costalis*, Walk.

Panchlora costalis, Walker, Cat. Blatt. Brit. Mus., p. 35 (1868).

♂. Eyes nearly touching on vertex of head. Head rufo-testaceous; antennae testaceous at base, remainder fuscous. Pronotum margined broadly all round with testaceous, disc castaneous at base, apex hyaline, outer margin testaceo-hyaline. Wings hyaline, costal margin faintly suffused with ochreous, ulnar vein with 10 rami, 7 of which are incomplete. Abdomen and legs flavo-testaceous. Supra-anal lamina sub-quadrate, not surpassing the sub-genital lamina, which is small and slightly asymmetrical.

Total length 15 mm.; length of body 13 mm.; length of tegmina 12 mm.; pronotum 4 mm. × 6 mm.

"WEST AFRICA" (British Mus., type); TOGO (Berlin Mus.).

The species is to be distinguished by the broad testaceous margin running all round the pronotum and by the apical three-fifths of the tegmina being hyaline, the castaneous colouring of the tegmina occupies the basal two-fifths, and is produced along the marginal field towards the apex.

4. *G. castanea*, sp. n.

♂. Differs from *scutelligera* and *costalis* by the greater distance apart of the eyes on the vertex of the head. Head rufo-testaceous, vertex between the eyes, which are nearly 1 mm. apart, castaneous. Pronotum with disc castaneous, margins broadly flavo-testaceous, at the postero-lateral angles the castaneous almost reaches the outer border of the pronotum. Tegmina dark castaneous, flavo-marginate almost to their apex. Wings suffused with castaneous. Abdomen and legs as in the preceding species.

Total length, 16 mm.; length of body 14.8 mm.; length of tegmina 14 mm.; pronotum 5 mm. × 6 mm.

TOGO, Bismarckburg (*L. Conradt*), (Berlin Mus.).

5. *G. gloriosa*, Stål.

Blatta gloriosa, Stål, Oefv. Vet.-Akad. Förh., xii, p. 351 (1856).

Panchlora africana, Saussure, Rev. Zool. (2), xvi, p. 342 (1864).

Gyna africana, Saussure, Mém. Soc. Sci. Phys. Nat. Genève, xx, p. 275 (1869).

Gyna pomposa, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 269 (1865).

A common species ranging from Sierra Leone to the Congo.

6. *G. jocos*a, Shelf.

*Gyna jocos*a, Shelford, Mém. Soc. ent. Belg., xv, p. 234 (1908).

CONGO FREE STATE (Brussels Mus., type; British Mus.).

7. *G. laticosta*, Walk.

Panchlora laticosta, Walker, Cat. Blatt. Brit. Mus., p. 33 (1868).

Gyna buchholzi, Gerstaecker, Mitt. Ver. Neuvorpomm u. Rügen, xiv, p. 72 (1883).

? *Apotrogia angolensis*, Kirby, Ann. Mag. Nat. Hist., ser. 7, v, p. 281 (1900); Distant's Ins. Transvaal, p. 21, Pl. I, fig. 11 (1900).

A handsome species, readily distinguished by the obsolescent markings on the pronotum and by its primrose-yellow colour.

KAMERUN (Greifswald Mus., type of *buchholzi*; Oxford Mus.; Berlin Mus.; coll. Bolivar); FERNANDO PO (Greifswald Mus.); ANGOLA (British Mus., type of *laticosta*).

8. *G. oblonga*, Borg.

Gyna oblonga, Borg, Bih. Svensk. Vet.-Akad. Handl., xxviii, Afd. 4, No. 10, p. 21, Pl. II, fig. 1 (1902).

The form and extent of the markings on the pronotum varies considerably; a reliable character is presented by the oblique fascia at the apex of the tegmina, which is present in all the specimens of both sexes that I have seen.

KAMERUN (Stockholm Mus., type; Oxford Mus.; Berlin Mus.; coll. Bolivar).

9. *G. nigrifrons*, Bol.

Gyna nigrifrons, Bolivar, J. Sci. Lisboa (2) i, p. 77 (1889).

BENGUELLA (Lisbon Mus., type); Loanda (coll. Bolivar).

10. *G. peringueyi*, sp. n.

♂. Testaceous. Eyes on vertex 1 mm. apart. Vertex and frons not striate. Four stripes on the vertex, the vertex between the eyes, a macula between the antennal sockets, two spots on the clypeus, castaneous; antennae castaneous at base, remainder fuscous. Pronotum faintly striate posteriorly, lyrate markings clearly defined. Tegmina mottled with testaceous, no rufescent macula on disc, a piceous spot between radial and mediastinal veins. Wings slightly infuscated, ulnar vein with 11 rami, 7 being incomplete. Abdomen testaceous mottled with castaneous; supra-anal and sub-genital laminae of usual shape. Legs pale testaceous, posterior metatarsi elongate.

Total length 20 mm.; length of body 17 mm.; length of tegmina 18 mm.; pronotum 5.1 mm. × 6.8 mm.

BENGUELLA (Cape Town Mus., type).

11. *G. centurio*, Dohrn.

Gyna centurio, Dohrn, Stettin Ent. Zeit., xlix, p. 129 (1888).

A very distinct species on account of the opaque testaceous or flavous macula in the mediastinal field of the tegmina.

KAMERUN (Stettin Mus., type; Oxford Mus.).

12. *G. sculpturata*, sp. n.

♂. Testaceous, the pigment evenly distributed. Eyes almost touching on vertex; a castaneous band between the ocelli. Antennae piceous, 4-6 joints beyond the middle and 4 joints immediately before the apex ochreous. Pronotum more strongly produced posteriorly than usual, the process transversely striate, its apex and border very narrowly piceous, disc with the usual lyrate marking. Tegmina rather narrow, with variable piceous mottlings in the anal field and at the apex, usually a piceous macula in the middle of the disc, a line along the mediastinal vein at base and the anal vein piceous, mediastinal area and costal margin beneath castaneous. Wings hyaline, with the marginal field flavid, becoming castaneous at apex, ulnar vein with 12 rami, 7 being incomplete. Abdomen above and beneath and the legs flavo-testaceous. Supra-anal lamina sub-bilobate, considerably exceeding the sub-genital lamina which is small and asymmetrical, styles slender. Cerci small, 11-jointed.

♀. Similar, but much larger. Tegmina unicolorous, abdomen beneath and legs rufo-castaneous. Distance of eyes apart rather less than length of 1st antennal joint. Supra-anal lamina bilobed, exceeding the sub-genital lamina which is ample, produced, with sinuate margins.

♂. Total length 26 mm.; length of body 19 mm.; length of tegmina 19 mm.; pronotum 6.2 mm. × 7.6 mm.

♀. Total length 39 mm.; length of body 33 mm.; length of tegmina 33 mm.; pronotum 12 mm. × 13 mm.

KAMERUN (Berlin Mus., ♂ type; Deutsches Entom. Nat. Mus.; coll. Bolivar); BENIN (Oxford Mus., ♀ type); TOGO (Berlin Mus.).

13. *G. actola*, sp. n.

♂. Eyes touching on vertex of head. Frons castaneous and concave, vertex striate; antennae castaneous at base, remainder fuscous. Pronotum striate posteriorly and anteriorly, with the usual lyrate marking on disc. Tegmina rufo-testaceous, mottled, a piceous spot

between the mediastinal and radial veins, a rufescent macula on the disc. Wings with marginal field flavous, ulnar vein with 11 rami, 7 being incomplete. Abdomen rufo-testaceous; supra-anal lamina sub-quadrate, apex distinctly emarginate, sub-genital lamina of usual shape. Legs concolorous with abdomen, posterior metatarsi moderately elongate.

♀. Differs only in the greater distance apart of the eyes, larger size, sub-bilobate supra-anal lamina and ample, semi-orbicular sub-genital lamina.

♂. Total length 25–26 mm.; length of body 20–22 mm.; length of tegmina 19–22 mm.; pronotum 6.1 mm. × 8 mm.

♀. Total length 30 mm.; length of body 28 mm.; length of tegmina 25.5 mm.; pronotum 10 mm. × 11.8 mm.

FRENCH GUINEA, Kouroussa (Oxford Mus., ♂ type; Paris Mus.); PORTUGUESE GUINEA, Bolama (*L. Fca*), (Genoa Mus.), ♀ type.

This is a species that hitherto I have referred to *G. aestuans*, Sauss., but on examining the type of that species I find that it is different from the French and Portuguese Guinea examples here described.

14. *G. maculipennis*, Schaum.

Panchlora maculipennis, Schaum, Ber. Akad. Berlin, 1853, p. 776; Peters, Reise Mossamb., Zool. v, p. 109, Pl. VII, fig. 1 (1862).

Gyna vetula, Brunner von Wattenwyl, Nouv. Syst. Blatt., p. 267 (1865).

Distinguished by the piceous antennae, the tegmina mottled with testaceous and the contiguous eyes in the male.

GERMAN EAST AFRICA (Vienna Mus., type of *vetula*; Berlin Mus.; Stockholm Mus.); MOZAMBIQUE (Berlin Mus., type of *maculipennis*); RHODESIA (Oxford Mus.).

15. *G. kazungulana*, Gig.-Tos.

Gyna kazungulana, Giglio-Tos, Boll. Mus. Torino xxii, No. 563, p. 3 (1907).

This is little more than a local race of the preceding species, it is smaller in size but otherwise scarcely differs. The type specimen has the pronotum heavily suffused with castaneous, but this is not the case in an example

from Kilimandjaro which I am unable otherwise to distinguish from the type.

UPPER ZAMBESI, Kazungulu (Turin Mus., type); Kilimandjaro (Buda-Pesth Mus.).

16. *G. lurida*, Sauss.

Gyna lurida, Saussure, Abh. Senckenb. Ges., xxi, p. 581 (1899).

The female is to be distinguished from that of *maculipennis* by the different form of the supra-anal lamina.

ZANZIBAR (Senckenberg Mus., types; Vienna Mus.).

The last three species are so closely allied, that the following tabulation of the differences between the males will help towards their identification.

	<i>maculipennis.</i>	<i>kazungulana.</i>	<i>lurida.</i>
Length of body	19 mm.	15.2 mm.	15 mm.
Distance apart of eyes	Equals thickness of first antennal joint	Equals thickness of first antennal joint	Almost touching
Colour of head	Rufo-castaneous	Rufo-castaneous	Piceous
Colour of antennae	First two joints castaneous, remainder piceous	First two joints castaneous, remainder piceous	Piceous to base
Frons above clypeus	Smooth	Striate	Strongly striate
Supra-anal lamina	Sub-quadrate, apex faintly emarginate	Sub-quadrate, apex distinctly emarginate	Trigonal, apex faintly emarginate

17. *G. incommoda*, sp. n.

♂. Pale flavo-testaceous. Antennae fuscous, castaneous at base. Eyes nearly touching on vertex. Frons and face rufous. Posterior part of pronotum hyaline, lyrate markings rufo-castaneous. Tegmina moderately broad, outer margin sinuate, uniform flavo-testaceous becoming hyaline towards apex. Wings with anterior part suffused with flavid, ulnar vein with 14 rami, 9 being incomplete.

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Margins of pronotum beneath and mediastinal area of tegmina beneath bright rufo-castaneous. Abdomen and legs rufo-testaceous. Supra-anal lamina sub-quadrate, apex slightly emarginate, barely exceeded by the sub-genital lamina which is asymmetrical and furnished with two styles.

♀. Similar but rather darker in colour, distance of eyes apart rather greater than length of 1st antennal joint. Antennae piceous, castaneous at base. Posterior part of pronotum concolorous with anterior part. Tegmina broader, their outer margin very sinuate. Wings with anterior part suffused with rufo-castaneous.

♂. Total length 22 mm.; length of body 16 mm.; length of tegmina 20 mm.; pronotum 6.8 mm. × 8 mm.

♀. Total length 28 mm.; length of body 21 mm.; length of tegmina 25 mm.; pronotum 8.5 mm. × 10.9 mm.

SOMALILAND, Brava (Genoa Mus., types ♂ and ♀);
GERMAN E. AFRICA, Lake Jipe, Katona (Budapest Mus.).

The species is perhaps most nearly related to *G. lat costa*, Walk., but is distinguished by the well-defined lyrate markings on the pronotum. The specimen from Katona is rather larger than the type ♀, but otherwise is identical.

18. *G. fervida*, Sauss.

Panchlora fervida, Saussure, Rev. Zool. (2) xvi, p. 341 (1864).

Panchlora lata, Walker, Cat. Blatt. Brit. Mus., p. 31 (1868).

Panchlora spurcata, Walker, op. cit., p. 34 (1868).

? *Trichomera insignata*, Kirby, Ann. Mag. Nat. Hist., ser. 6, xviii, p. 257, Pl. XII, f. 5 (1896).

♂. Testaceous. Distance apart of eyes on vertex of head equal to length of 1st antennal joint; frons with castaneous macula; neither vertex nor frons striate. Antennae rufo-fuscous, basal third rufo-testaceous. Pronotum with clearly defined lyrate marking. Tegmina rather broad, mottled with testaceous, a macula on disc and a curved fuscia at apex, rufescent; the piceous spot between radial and mediastinal veins obsolescent or absent. Wings hyaline, the marginal field flavo-testaceous, ulnar vein with 10 rami, 7 being incomplete. Abdomen and legs rufo-testaceous; supra-anal lamina sub-quadrate, apex not emarginate, barely surpassing the sub-genital plate which is small and slightly asymmetrical. Tarsi rather short.

♀. Similar, but eyes a little farther apart; tegmina broader;

anterior part of wings suffused with castaneous, ulnar vein with 11 rami; supra-anal lamina sub-bilobate; sub-genital lamina semi-orbicular, ample.

♂. Total length 20 mm.; length of body 17 mm.; length of tegmina 16 mm.; pronotum 6 mm. × 8 mm.

♀. Total length 27 mm.; length of body 24 mm.; length of tegmina 22 mm.; pronotum 8.5 mm. × 10 mm.

SENEGAMBIA (Paris Mus., type of *fervida*); GAMBIA (British Mus., type of *lata*); TOGO (Berlin Mus.); BENIN (Oxford Mus.); GABOON (British Mus., type of *spurcata*); CONGO FREE STATE (Brussels Mus.).

19. *G. aestuans*, Sauss.

Panchlora aestuans, Saussure, Mém. Soc. Sci. Phys. Nat. Genève, xvii, p. 159, Pl. I, f. 20 (1864).

♂. Differs from *fervida* by the smaller distance apart of the eyes, the strongly striate vertex, the more heavily marked frons, the piceous antennae, the concolorous tegmina without macula or fascia, the supra-anal lamina with slightly emarginate apex.

Length of body 17.3 mm.; length of tegmina 20 mm.; pronotum 7 mm. × 9 mm.

SENEGAL (Geneva Mus., type).

20. *G. caffrorum*, Stål.

Panchlora caffrorum, Stål, Oefv. Vet.-Akad. Förh. xiii, p. 167 (1856).

Epilampra conspicua, Walker, Cat. Blatt. Brit. Mus., p. 67 (1868).

Panchlora scripta, Walker, op. cit., p. 183 (1868).

Gyna fervida, Bormans, Ann. Soc. ent. Belg., xxv, p. 21, Pl. I, f. B. (1881).

Gyna stridulans, Karny, Denkschr. med.-nat. Ges. Jena, xiii, p. 382, Pl. XXI, f. 28, Pl. XXII, ff. 29-32 (1908).

To be distinguished from *G. maculipennis* by the eyes being nearly 1 mm. apart in the ♂; the vertex is striate and the pronotum is usually heavily marked. Dr. Karny has kindly compared a specimen of *caffrorum* with his species and informs me that they are practically identical.

NATAL (Stockholm Mus., type of *caffrorum*); "SOUTH

AFRICA" (British Mus., type of *scripta*; Oxford Mus., *Borman's example*); LAKE N'GAMI (*Castelnau*), (British Mus., type of *conspicua*; Oxford Mus.); S.W. AFRICA, Amboland (*G. Schinz*), (Senckenberg Mus.); GERMAN S.W. AFRICA, Otjosondou (Berlin Mus., type of *stridulans*).

21. *G. aurivillii*, Borg.

Gyna aurivillii, Borg, Bih. Svensk. Vet.-Akad. Handl., xxviii, Afd. 4, No. 10, p. 20, Pl. II, f. 5 (1902).

This is very close to the preceding species, but the eyes in the ♂ are closer together and in both sexes the tegmina have no rufescent macula on the disc of the tegmina, there is however a conspicuous piceous spot between the radial and mediastinal veins which is reduced or absent in *caffrorum*. The fusing of the lyrate markings on the vertex is a variable character.

♂. Total length 27 mm.; length of body 23 mm.; length of tegmina 24 mm.; pronotum 8.4 mm. × 9.4 mm.

KAMERUN (Stockholm Mus., type; Berlin Mus.).

22. *G. hyalina*, sp. n.

♀. Clear testaceo-hyaline, head and antennae, abdomen and legs rufo-castaneous. Eyes close together on vertex (less than 1 mm. apart). Pronotum anteriorly and posteriorly faintly striate, lyrate markings on disc castaneous and fused together. Tegmina moderately broad, immaculate, mediastinal field at base, mediastinal and anal veins castaneous. Wings with costal margin suffused with flavid, ulnar vein with 17 rami, 11 being incomplete. Supra-anal lamina deeply bilobate, sub-genital lamina of the usual form. Formula of apical spines of the femora, 2, 1, 1; no genicular spine on front femora.

Total length 24 mm.; length of body 17.8 mm.; length of tegmina 20 mm.; pronotum 6.9 mm. × 8 mm.

CONGO FREE STATE, Iringui (Musée du Congo); VICTORIA NYANZA, Bugala, Sesse Archipelago (*E. Bayon*), (Genoa Mus.).

Readily distinguished by the peculiar hyaline appearance of the pronotum and tegmina; also by the approximation of the eyes, an unusual feature in the females of this genus.

23. *G. colini*, Rochebr.

Gyna colini, Rochebrune, Bull. soc. philomath., ser. 7, vii, p. 176 (1883).

The description is useless for purposes of identification, and I cannot obtain the type.

SENEGAMBIA.

Genus PSEUDOGYNA, nov.

Allied to *Gyna*, Br., but differs as follows:—pronotum posteriorly less strongly produced; tegmina and wings not exceeding apex of abdomen; cerci very short and obscurely articulated; posterior metatarsus very long, considerably exceeding the succeeding joints, biserially spined beneath.

The genus is intermediate between *Gyna* and *Phenacisma*.

P. intermedia, sp. n.

♀. Head piceous, genae and mouth-parts testaceous. Eyes rather wide apart. Pronotum testaceous with a discoidal piceous lyrate marking, posteriorly produced but much less so than in *Gyna* and *Phenacisma*. Tegmina not quite extending to apex of abdomen, castaneous, mediastinal field testaceous, venation well marked, mediastinal vein piceous. Wings of equal length with tegmina, anterior part semi-coriaceous, posterior part slightly reduced, ulnar vein ramose. Abdomen mottled with testaceous and piceous; supra-anal lamina quadrate, apex emarginate; sub-genital lamina semi-orbicular, ample. Legs castaneous.

Length 25 mm.; length of tegmina 19·5 mm.; pronotum 7·1 mm. × 10 mm.

N.E. RHODESIA, Hills near Fort Jameson, 4,000–5,000 ft. (*S. A. Neave*), (Oxford Mus.).

In colouring the species is very like the next.

Genus PHENACISMA, Karsch.

Phenacisma semialata, sp. n. (Pl. IX, fig. 38.)

♀ Allied to *P. peltata*, Karsch, but smaller and less convex, tegmina coriaceous not semi-corneous, more rounded at apex, anal vein well marked, wings larger. Head piceous, a band between the

eyes and the mouth-parts rufo-testaceous. Eyes rather wide apart. Antennae piceous. Pronotum as in *peltata*, but discoidal lyrate marking larger. Tegmina suffused with castaneous, not extending beyond apex of abdomen. Wings much reduced, coriaceous, veins thickened, ulnar vein with 12 rami, vena dividers giving off transverse venules, posterior part of wing not folding in fan-like manner. Abdomen testaceous, mottled with fuscous, supra-anal lamina quadrate, apex slightly emarginate. Cerci very short, sub-genital lamina semi-orbicular, ample. Coxae testaceous, legs castaneous, posteriori arsi as in *P. peltata*.

Length 23 mm.; length of tegmina 19 mm.; length of wings 10 mm.; pronotum 8 mm. \times 11.2 mm.

N.E. RHODESIA, E. Loangwa district, Petauke 2,400 ft. (*S. A. Neave*), (Oxford Mus.).

In *P. peltata*, Karsch, the wings are reduced to minute corneous scales from which the venation has disappeared, these scales represent only the anterior parts of the wings; *semialata* in its wing-structure is a connecting link between *Pseudogyna* and *peltata*.

The genus *Gynopeltis*, Gerst. (sub-fam. *Perisphaeriinae*) in the male sex is very like *Gyna*, Br., but may be distinguished by the shortly produced, trigonal supra-anal lamina, exceeded by the sub-genital lamina and by a hooked lappet, which is the left posterior angle of the 8th abdominal sternite, projecting from beneath the 7th abdominal sternite on the left side; there is only one style and this is minute. In *G. cryptospilo*, Wlk. [= *picta*, Gerst.] the front femora have four or five spines on the anterior margin beneath. The females of the genus are entirely apterous.

The following species appears to be new:—

Gynopeltis newei, sp. n. (Pl. IX, fig. 39.)

♂ Testaceous; head with vertex and an irregular band between the ocelli castaneous. Eyes .75 mm. apart; antennae piceous. Pronotum with a lyrate piceous marking on the disc as in the genus *Gyna*. Tegmina testaceous, rather narrow, outer margin sinuate, a line at base of mediastinal vein and the anal vein piceous, disc indistinctly suffused with castaneous, the part of the right tegmen overlapped by the left, castaneous. Wings with anterior part suffused with flavid, ulnar vein with 12 rami, 7 being incomplete. Abdomen above rufo-testaceous, beneath testaceous. Cerci rather

stout, incurved. Legs testaceous, piceous above, front femora unarmed on anterior margin beneath.

Total length 27 mm. ; length of body 22 mm. ; length of tegmina 24 mm. ; pronotum 6.2 mm. \times 8mm.

N.F. RHODESIA, East Loangwa district, Petauke 2,400 ft. (*S. A. Neave*), (Oxford Mus.).

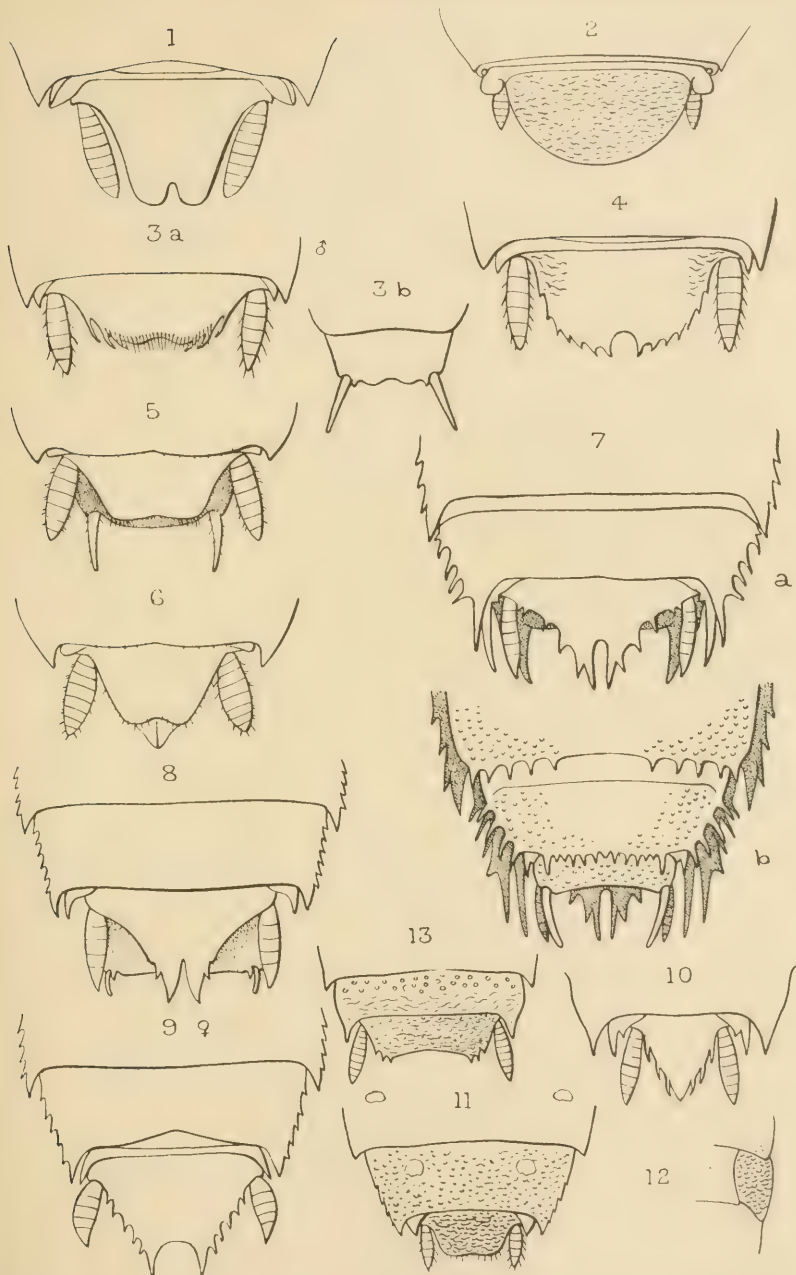
EXPLANATION OF PLATES VII-IX.

[*See Explanation facing the PLATES.*]

JUNE 4, 1909.

EXPLANATION OF PLATE VII.

- FIG. 1. *Polyzosteria pubescens*, Tepp., ♀.—Apex of abdomen, dorsal view.
2. *Euzosteria patula*, Walk., ♀.—Apex of abdomen, dorsal view.
3. *Platyzoisteria melanaria*, Er., ♂.—Apex of abdomen, *a*, dorsal view, *b*, ventral view.
4. *Platyzoisteria melanaria*, Er., ♀.—Apex of abdomen, dorsal view.
5. *Platyzoisteria aterrima*, Er., ♂.—Apex of abdomen, dorsal view.
6. *Platyzoisteria aterrima*, Er., ♀.—Apex of abdomen, dorsal view.
7. *Platyzoisteria ferox*, sp. n., ♂.—Apex of abdomen, *a*, dorsal view, *b*, ventral view.
8. *Platyzoisteria armata*, Tepp., ♂.—Apex of abdomen, dorsal view.
9. *Platyzoisteria armata*, Tepp., ♀.—Apex of abdomen, dorsal view.
10. *Platyzoisteria bifida*, Sauss., ♂.—Apex of abdomen, dorsal view.
11. *Platyzoisteria punctata*, Br., ♀.—Apex of abdomen, dorsal view.
12. *Platyzoisteria novae-seelandiae*, Br., ♂.—Left tegmen.
13. *Platyzoisteria variolosa*, Bol., ♂.—Apex of abdomen, dorsal view.



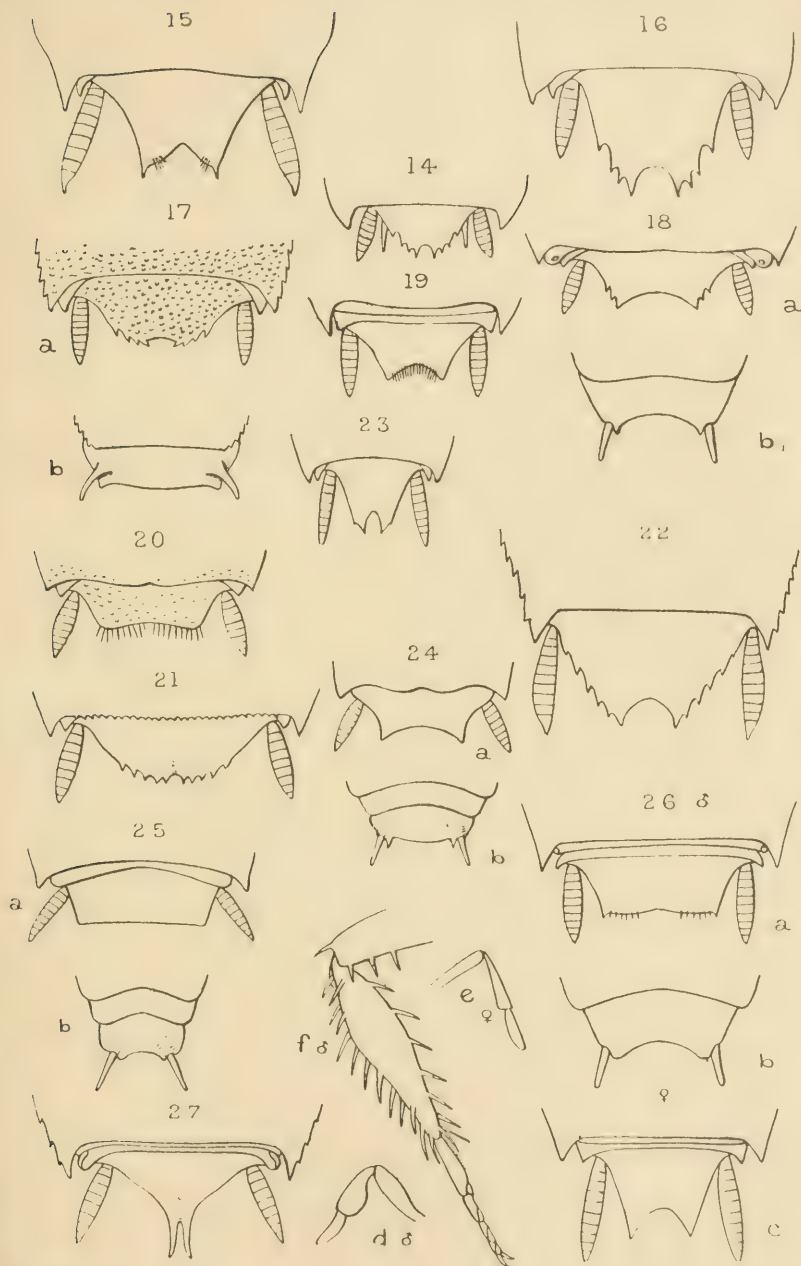
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AUSTRALIAN BLATTINAE.

EXPLANATION OF PLATE VIII.

- FIG. 14. *Platyzosteria atrata*, Er., ♂.—Apex of abdomen, dorsal view.
15. *Platyzosteria invisa*, Walk., ♂.—Apex of abdomen, dorsal view.
16. *Platyzosteria invisa*, Walk., ♀.—Apex of abdomen, dorsal view.
17. *Platyzosteria punctata*, Br., ♂.—Apex of abdomen, *a*, dorsal view, *b*, ventral view.
18. *Platyzosteria castanea*, Br., ♂.—Apex of abdomen, *a*, dorsal view, *b*, ventral view.
19. *Platyzosteria obscura*, Tepp., ♂.—Apex of abdomen, dorsal view.
20. *Platyzosteria scabriuscula*, Tepp., ♂.—Apex of abdomen, dorsal view.
21. *Platyzosteria morosa*, Shelf., ♂.—Apex of abdomen, dorsal view.
22. *Platyzosteria albomarginata*, Br., ♂.—Apex of abdomen, dorsal view.
23. *Platyzosteria obscuripes*, Tepp., ♂ nymph.—Apex of abdomen, dorsal view.
24. *Platyzosteria soror*, Br., ♂.—Apex of abdomen, *a*, dorsal view, *b*, ventral view.
25. *Platyzosteria communis*, Tepp., ♂.—Apex of abdomen, *a*, dorsal view, *b*, ventral view.
26. *Platyzosteria semivitta*, Walk.—*a*, Apex of abdomen ♂ dorsal view, *b*, ditto ventral view, *c*, apex of abdomen ♀ dorsal view, *d*, maxillary palp ♂, *e*, maxillary palp ♀, *f*, posterior tibia ♂.
27. *Platyzosteria coolgardiensis*, Tepp., ♂.—Apex of abdomen, dorsal view.



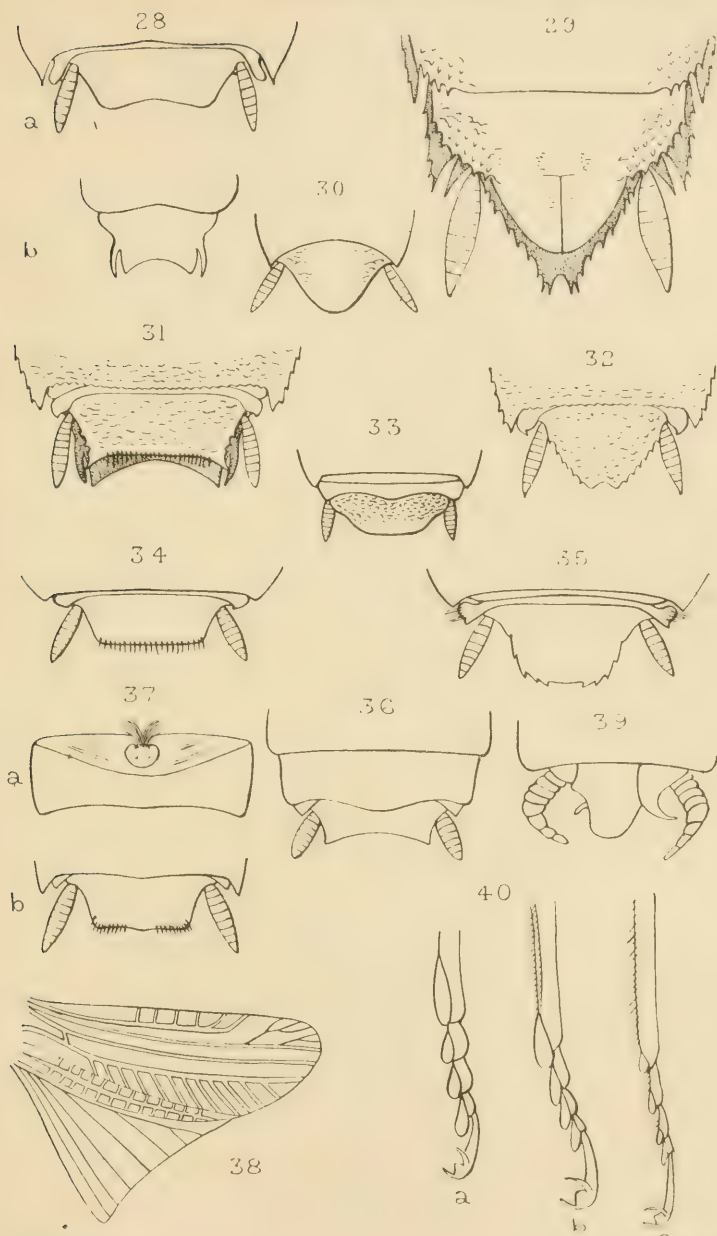
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AUSTRALIAN BLATTINAE.

EXPLANATION OF PLATE IX.

- FIG. 28. *Zonioploca pallida*, Shelf., ♂.—Apex of abdomen, *a*, dorsal view, *b*, ventral view.
29. *Platyzoisteria aposematica*, sp. n., ♀.—Apex of abdomen, ventral view.
30. *Platyzoisteria rufoterminalata*, Br., ♀.—Apex of abdomen, dorsal view.
31. *Cosmozosteria zonata*, Walk., ♂.—Apex of abdomen, dorsal view.
32. *Cosmozosteria zonata*, Walk., ♀.—Apex of abdomen, dorsal view.
33. *Cosmozosteria bicolor*, Sauss., ♀.—Apex of abdomen, dorsal view.
34. *Anamesia polyzona*, Walk., ♂.—Apex of abdomen, dorsal view.
35. *Anamesia polyzona*, Walk., ♀.—Apex of abdomen, dorsal view.
36. *Temnelytra undulivitta*, Walk., ♂.—Apex of abdomen, dorsal view.
37. *Temnelytra truncata*, Br., ♂.—*a*, 1st and 2nd abdominal tergites, *b*, apex of abdomen, dorsal view.
38. *Phenacisma semialata*, sp. n., ♀.—Left wing.
39. *Gynopeltis neavei*, sp. n., ♂.—Apex of abdomen, dorsal view.
40. Posterior tarsus of, *a*, *Polyzoisteria limbata*, *b*, *Cutilia nitida*, *c*, *Blatta orientalis*.



H. Knight del.

C. Hentschel.

AUSTRALIAN AND AFRICAN BLATTIDAE.

On a small collection of Blattidae in the Naturhistorischen Museum zu Wiesbaden.

By

R. Shelford, M. A., F. L. S.

Mit Tafel I.

The collection of Blattidae which Herr Ed. Lampe of the Wiesbaden Museum has entrusted to me for determination includes a few species of considerable interest and a complete list of them is given herewith. The types of the new species are in the Wiesbaden Museum but duplicates of some species have been generously presented to the Oxford University Museum (Hope Department).

Fam. BLATTIDAE.

Subfam. **Ectobiinae**.

Genus **Hemithyrsocera**, Sauss.

Hemithyrsocera histrio, Burm.

1 ♂, Palembang, Sumatra (coll. A. Fuchs, 1902).

Subfam. **Phyllodromiinae**.

Genus **Phyllodromia**, Serv.

Phyllodromia germanica, L.

2 ♂♂, Palembang, Sumatra (coll. A. Fuchs, 1902); 1 ♀, 1 larva.
Iguazu, Argentine (coll. K. Seyd, 1907).

Phyllodromia contingens, Walk.

1 ♂, S. Atjeh, Sumatra (coll. A. Fuchs, 1902).
Previously recorded from Sarawak, Borneo.

Phyllodromia hemerobina, Gerst.

1 ♀. Bibundi, Cameroons (coll. J. Weiler and O. Rau, 1907).

Genus **Ischnoptera**, Burm.**Ischnoptera australis**, Sauss.

One example with the abdomen missing, Australia (coll. Odernheimer).

Genus **Loboptera**, Br.**Loboptera bergeri**, sp. n.

♀. Piccous. Head castaneous, antennae fuscous. Lateral margins of pronotum with a hyaline fascia, failing to reach the posterior margin. Tegmina with outer margin hyaline; broader than long, with faint indications of the venation, the apex of the marginal area truncate, the apex of the discoidal area rounded. Metanotum with a large quadrate hyaline macula on each side of the middle line anteriorly. Dorsal abdominal tergites 3—7 each with a lateral hyaline spot, the spots on the 5th tergite minute, the 7th tergite with a pair of central spots also. Supra-anal lamina triangular, apex emarginate, its disc testaceo-hyaline. Cerci testaceous except at the base. A very sparse minute pubescence on the abdomen and coxae. Abdomen beneath castaneous, a lateral hyaline spot on sternites 2 and 3. Sub genital lamina semi-orbicular, ample. Legs testaceous, the bases of the coxae and tibiae, the apices of the femora and tibiae, castaneous. [Front legs missing.]

Total length 11 mm; tegmina 1,8 mm \times 2 mm; pronotum 3 mm \times 4 mm.

Rietmond, Gibeon, German S. W. Africa (coll. C. Berger). One specimen.

Distinguished by the form of the tegmina, which are intermediate in shape between the squamiform *Loboptera*-type and the quadrate *Temnopteryx*-type.

Genus **Paraloboptera**, Sauss.**Paraloboptera weileri**, sp. n.

♂. Fusco-castaneous. Basal joints of antennae and the mouth-parts testaceous. Head rufo-castaneous. Pronotum laterally bordered with rufo-testaceous. Tegmina rufo-testaceous. Metanotum with a curved transverse testaceous band. Abdomen beneath with the disc rufous, laterally dark castaneous. Supra-anal lamina triangular. Sub-genital lamina asymmetrical, apex slightly produced, a pair of small styles. [Cerci mutilated] — Legs testaceous.

Total length 10 mm; length of tegmina 2 mm; pronotum 3 mm.
 $\times 4,1$ mm.

Bibundi, Cameroons (coll. J. Weiler and O. Rau, 1907).

One example.

Subfam. **Epilamprinae.**

Genus **Phoraspis**, Serv.

Phoraspis luteola, Blanch.

2 ♀♀, Sao Paulo, Brazil (P. Preiss, 1907).

From the apex of the abdomen of one example an egg-mass protrudes; the ova are in an advanced stage of development and this species is evidently viviparous as are so many other, if not all, the Epilamprinae.

Genus **Opisthoplatia**, Br.

Opisthoplatia orientalis, Burm.

1 ♂, 1 ♀, Hongkong (coll. K. Seyd, 1908).

Genus **Compsolampra**, Sauss.

Compsolampra liturata, Serv.

1 ♀, Kandy, Ceylon (coll. K. Seyd, 1908).

Previously recorded from Java.

Genus **Molytria**, Stål.

Molytria badia, Br.

1 ♂, 1 ♀, S. Atjeh, Sumatra (coll. A. Fuchs, 1902).

Previously recorded from Borneo, Java and Singapore.

Genus **Epilampra**, Burm.

Epilampra erubescens, Gerst.

1 larva, Bibundi, Cameroons (coll. J. Weiler and O. Rau).

Genus **Tribonoidea**, nov.

Belongs to the section of Epilamprinae with long metatarsus, biserially spined beneath and differs from the known genera in that section by the cucullate pronotum, more arcuate anteriorly than posteriorly and with slightly reflected margin. Tegmina and wings longer than

the abdomen. Mediastinal vein of tegmina laminate beneath. Supra-anal lamina (♂) bilobed. Femora sparsely armed. Tarsal arolia very small.

Tribonoidea seydi, sp. n.

♂. Dark castaneous. Antennae rather short, first joint elongate. Eyes rather close together. Face and mouth parts testaceous. Pronotum reticulate-punctate, a pair of oblique impressions and a pair of smooth spaces defining a central area beneath which lies the head. Anteriorly the pronotum extends considerably beyond the head; near the posterior margin there is a short transverse carina and in the neighbourhood of this the pronotum is transversely striate; a median carina. Tegmina with mediastinal and anal fields reticulate, costals and discoidal sectors very ramose. Wings with mediastinal vein very long and irregularly ramose, costals irregular, ulnar vein multiramose. Supra-anal lamina bilobed exceeding the sub-genital lamina; styles minute. Cerci very short. Abdomen beneath and legs testaceous. Posterior margins of all the femora beneath unarmed; front femora with 3—4 spines, mid femora with 2 spines, hind femora with 3 spines, on the anterior margin beneath. Formula of apical spines $\frac{1}{1}$, $\frac{1}{0}$, $\frac{1}{0}$, genicular spines minute, none on front femora. Posterior metatarsus exceeding the remaining joints in length; pulvilli moderate, spined.

Total length 30 mm; length of body 21,2 mm; length of tegmina 25 mm; pronotum 6,2 mm \times 9,6 mm.

Oxapampa, Peru (coll. K. Seyd, 5. V. 07). One example.

The systematic position of this genus is somewhat uncertain. Superficially the insect closely resembles species of the genera *Tribonidium* and *Zetobora* but the tarsal structure excludes it from the sub-family Panchlorinae. The presence of tarsal arolia also excludes it from the Blaberinae with which sub-family it exhibits some affinities — e. g. the sparse armature of the femora. I have therefore no option but to place it provisionally in the Epilamprinae.

Subfam. **Blattinae**.

Genus **Polyzosteria**, Burm.

Polyzosteria limbata, Burm.

1 ♂, Australia (coll. Odernheimer).

Genus **Stylopyga**, Fisch.-Waldh.

Stylopyga coxalis, Walk.

Several examples of both sexes, Stephansort, German New-Guinea (Bergmann, 1899 and A. Hofmann, 1904).

Stylopyga paralella, Bol.

1 ♂, 1 ♀, Kandy, Ceylon (coll. K. Seyd, 1908).

Stylopyga furcifera, sp. n. (Taf. 1, Fig. 1 A—C.)

♂ and ♀. Piceous, nitid, smooth, impunctate. Palpi pale testaceous, labrum and clypeus rufous. Tegmina squamiform. Seventh abdominal tergite produced in the middle. Supra-anal lamina (♂) produced, trapezoidal, posterior angles spinous, posterior margin widely emarginate; (♀) trigonal, cucullate, posterior angles spinous, apex emarginate. Sub-genital lamina (♂) sub-trapezoidal, apex cleft and bituberculate, a pair of stout bifurcate styles.

Total length 16—18 mm; pronotum 4,5—4,8 mm \times 6—6,2 mm. Bibundi, Cameroons (coll. J. Weiler and O. Rau 1905—1907). Several examples.

Stylopyga assimilis, sp. n. (Taf. 1, Fig. 2 A—B.)

♂ and ♀. Similar to the preceding species but supra-anal lamina (♂) trigonal, sub-cucullate with spinous angles, sub-genital lamina (♂) with posterior margin slightly sinuate, styles less stout, one limb of the bifurcation longer than the other.

Total length 17—20 mm; pronotum 5—5,8 mm \times 6,1—7 mm. Bibundi, Cameroons (coll. J. Weiler and O. Rau VIII—IX 1907). Several examples.

Stylopyga nigerrima, sp. n. (Taf. 1, Fig. 3 A—C.)

♂ and ♀. Similar to the preceding species, but smaller; palpi castaneous. Supra-anal lamina (♂) simply trigonal, (♀) trigonal, sub-cucullate, apex slightly emarginate. Sub-genital lamina with apex widely emarginate, posterior angles not spinous, styles very similar to those of *S. assimilis*. Total length 14—15 mm; pronotum 4—4,5 mm. \times 5—5,5 mm. Bibundi, Cameroons (coll. J. Weiler and O. Rau VIII—IX 1907).

The West African species of *Stylopyga* may be distinguished as follows:

1. Large, castaneous species . *S. manca*, Gerst. (Cameroons),
(Taf. 3, Fig. 4)
- 1'. Smaller, piceous species.
2. Supra-anal lamina (σ^7) produced to a point . . . *S. anthracina*, Gerst. (Cameroons),
- 2'. Supra-anal lamina (σ^7) not as above.
3. Styles not bifurcate. . . *S. spinulifera*, Krauss (San Thomé),
- 3'. Styles bifurcate,
4. Supra-anal lamina (σ^7 and ϕ) without spinous angles. . *S. nigerrima*, sp. n. (Cameroons),
- 4'. Supra-anal lamina (σ^7 and ϕ) with spinous angles,
5. Sub-genital lamina (σ^7) with apex cleft and tuberculate *S. furcifera*, sp. n. (Cameroons).
- 5'. Sub-genital lamina (σ^7) with apex sinuate . . . *S. assimilis*, sp. n. (Cameroons).

Periplaneta aethiopica, Sauss. is a species of *Pseudoderopeltis* and is not species of *Stylopyga* as recently suggested.

Genus *Periplaneta*, Burm.

Periplaneta americana, L.

2 $\sigma^7\sigma^7$, 1 ϕ , Bibundi, Cameroons (coll. J. Weiler and O. Rau) and Posadas, Argentine (coll. K. Seyd 1902).

Periplaneta australasiae, Fab.

Several examples from Bibundi, Cameroons (coll. J. Weiler and O. Rau 1907); Palembang, Sumatra (coll. A. Fuchs 1902); Java (coll. Fritze).

Periplaneta pallipalpis, Serv.

1 σ^7 , Ceylon (coll. Freudenberg).

Periplaneta funebris, Shelf.

1 ϕ , Cameroons (coll. F. Fuchs 1907).

Genus **Homalophilpha**, Stål.

Homalophilpha ustulata, Burm.

1 larva, Kandy, Ceylon (coll. K. Seyd 1908).

Genus **Pelmatophilpha**, Dohrn.

Pelmatophilpha sinhalensis, sp. n.

♂. Piceous, nitid. Ocelli and labial palpi testaceous; antennae, maxillary palpi and labrum castaneous. Eyes and antennal sockets equidistant. Pronotum without impressions, posteriorly truncate. Tegmina quadrate, extending to middle of second abdominal tergite, slightly scabrous, anal vein impressed, the other veins obsolete, outer angles rounded. Wings minute, coriaceous. Seventh abdominal tergite slightly produced in the middle. Supra-anal lamina sub-quadrate, posterior angles rounded, posterior border slightly emarginate, rufo-fimbriate, a central carina. Abdomen dark castaneous beneath, sub-genital lamina narrow, a pair of long slender styles. [Cerci missing]. Coxae and femora castaneous, femora strongly spined. Pulvilli large, covering the whole of the distal joints, posterior metatarsus biserially spined beneath. Total length 20 mm; length of tegmina 6,1 mm; pronotum $7 \times 9,8$ mm. Ceylon (coll. Freudenberg).

The relative distances apart of the eyes and antennal sockets is a most unreliable character on which to separate the New World genera of Blattidae with large pulvilli from the Old World genera; I hope to publish shortly a revision of the subfamily Blattinae in which it will be shown that the geographical boundaries of the genera Pelmatophilpha and Eurycotis must be considerably extended.

Subfam. **Corydiinae**.

Genus **Polyphaga**, Brullé.

Polyphaga sumatrensis, sp. n.

♂. Pale testaceous. Frons and vertex castaneous; eyes and ocelli equally far apart. Pronotum barely covering vertex of head, rufo-fimbriate and pubescent, disc rather darker than margins. Tegmina with a few obscure fuscous maculae, mediastinal vein laminated beneath, anal vein rounded. Ulnar vein of wings not flexuose at base. Supra-anal lamina narrow, apex slightly emarginate; sub-genital lamina slightly asymmetrical its margin thickened and fimbriate, styles minute. Posterior

metatarsus rather longer than remaining joints: calcar of posterior tibia equal to half the length of the metatarsus. Total length 21,5 mm; length of body 15 mm; length of tegmina 18,5 mm; pronotum 4 × 6 mm. Palembang, Sumatra (coll. A. Fuchs, 1902). One example.

It is surprising to find a species of this Palaearctic genus occurring in the tropics. The species is allied to *P. sinensis* Sauss. but is considerably smaller and paler in colour.

Genus *Tivia*, Wlk.

Tivia, Walker, Cat. Blatt. Brit. Mus. Suppl. p. 153 (1869).

Hemilatindia, Saussure, Ann. Mus. Civ. Genova vol. XXXV p. 83 (1895).

I have examined the types of *Tivia simulatrix*, Wlk. and *Hemilatindia doriana*, Sauss. and there can be no doubt but that these two species are congeneric; *Holocompsa fulva*, Burm. also belongs to this genus. De Saussure is in error in describing the tibial spines of *H. doriana* as bi-seriately arranged, for I find that they are triseriately arranged; for the rest, de Saussure's description is accurate and serves to characterise the genus well enough. It should however be noted that *Tivia* (= *Hemilatindia*) can scarcely be considered as intermediate between *Latindia* and *Euthyrrapha*, for in all its characters it approximates *Polyphaga* so closely that it is not easy to find a really satisfactory feature to discriminate between the two genera. In *T. simulatrix* Wlk. and *T. doriana* Sauss. the tarsal arolia are absent, whereas they are present in *T. fulva* and the new species here described; in the sub-family *Corydiinae* the presence or absence of tarsal arolia does not appear to be a character of much taxonomic importance, for it varies within the limits of certain genera e. g. *Polyphaga*, *Latindia*.

Tivia morosa, sp. n.

♂. Fuscous. Head castaneous, antennae testaceous at base; eyes rather close together on vertex of head, frons swollen, ocelli present and touching the eyes. Pronotum anteriorly strongly arcuate and covering the vertex of the head, posteriorly subtruncate, sides deflexed, anterior margin hyaline and rufo-fimbriate, remainder sparsely pubescent. Scutellum exposed. Tegmina considerably exceeding the apex of the abdomen, with some scattered hyaline spots, a distinct stigma in the middle of the marginal area, formed by the incrassation of the costal

veins; discoidal sectors flexuose, anal vein angulate. Wings with a large stigma in the middle of the marginal area, ulnar vein 6-ramose. Supra-anal lamina short, narrow; subgenital lamina with apex deeply cleft, a pair of slender styles. Cerci moderate, 10—11 jointed, the basal joint the largest. Front tibiae with 7 apical calcaria, hind tibia with 6; tibial spines in 3 rows. Tarsi with arolia. Total length 10,3 mm; length of body 8 mm; length of tegmina 8,2 mm; pronotum $2 \times 2,8$ mm.

Rietmond, Gibeon, German S. W. Africa (coll. C. Berger). Three males.

The species is most closely allied to *T. fulva*, Burm. as determined by Brunner.

Genus **Homaeogamia**, Burm.

Homaeogamia bolliana, Sauss.

1 ♂, S. Antonio, Texas (coll. F. Fuchs 1907).

Genus **Paralatindia**, Sauss.

Paralatindia obscura, sp. n.

♂. Castaneous with a pale pubescence. Vertex of head barely covered by pronotum; antennae fuscous, longer than the body; eyes wide apart; vertex not swollen. Pronotum cucullate, without impressions, anteriorly parabolic, posterior margin sub-sinuate, a median impressed line. Tegmina not extending beyond the 2nd abdominal tergite, ovate, veins obsolescent, mediastinal ramose, 4 costals, ulnar vein tri-ramose, anal vein impressed. Wings minute, coriaceous. Abdomen rufo-castaneous at base, remainder fuscous; supra-anal lamina sub-quadrate, its apex widely emarginate, sub-genital lamina semi-orbicular, a pair of slender testaceous styles. Cerci fuscous, acuminate. Front tibiae with one spine on anterior border and 4 apical spines, no spine on posterior border, mid- and hind-tibiae with a few spines on anterior border, biserially arranged, 5 apical spines, hind-tibiae with no spines on posterior border, mid-tibiae with one. No tarsal arolia.

Total length 8 mm; length of tegmina 2,3 mm; pronotum $2,5 \text{ mm} \times 3,1 \text{ mm}$.

Vauli, 4000 mètres, Peru (coll. K. Seyd, 13. V. 07). One example. Differs from the other species of the genus by the absence of tarsal arolia and by the pronotum without impressions.

Subfam. **Panchlorinae.**

Genus **Gyna**, Br.

Gyna capucina, Gerst.

6 ♂♂, 1 ♀. Bibundi, Cameroons (coll. J. Weiler and O. Rau, 1906, 1907).

Gyna gloriosa, Stål.

3 ♀♀, Bibundi, Cameroons (coll. J. Weiler and O. Rau, 1906, 1907).

Gyna oblonga, Borg.

1 ♂, Bibundi, Cameroons (coll. J. Weiler and O. Rau, 1907).

Genus **Nauphoeta**, Burm.

Nauphoeta cinerea, Oliv.

1 ♀, Bibundi, Cameroons (coll. J. Weiler and O. Rau). The characteristic dark variety of West Africa.

Genus **Oniscosoma**, Br.

Oniscosoma granicollis, Br.

1 ♀, 1 larva, Australia (coll. Odernheimer).

Subfam. **Blaberinae.**

Genus **Blabera**, Serv.

Blabera gigantea, L.

1 ♀, Cayenne (coll. Gerning).

Blabera postica, Erichs.

1 ♀, Java (coll. Fritze). There must either be some mistake in the locality label of this specimen, or else the specimen was accidentally imported into Java from South America.

Subfam. **Perisphaeriinae.**

Genus **Derocalymma**, Burm.

Derocalymma ? silphoides. Bol.

1 young larva, Bibundi, Cameroons (coll. J. Weiler and O. Rau). have determined this species with considerable doubt.

Genus **Cyrtotria**, Stål.

Cyrtotria robusta, sp. n.

♀. Closely allied to *C. gibbicollis* Stål. but larger and stouter. Pronotum very similar but the disc rugose and with the posterior angles more strongly produced. Abdomen broadly amplified. Legs castaneous, the tibiae darker than the femora.

Total length 15,8 mm; pronotum 4,9 mm \times 6 mm.

Rietmond, German S. W. Africa (coll. C. Berger, 1903). One example.

Genus **Isoniscus**, Borg.

Isoniscus sjöstedti, Borg.

3 ♀♀, Bibundi, Cameroons (coll. J. Weiler and O. Rau, 1906).

I consider that this genus is more naturally placed in this subfamily than in the Panchlorinae. It is somewhat remarkable that the male has not yet been found, though large collections have been made in the Cameroons.

Genus **Dasyposoma**, Br.

Dasyposoma nigra, Br.

1 ♂, 1 ♀ Iguazu, Argentine and Oxapampa, Peru (coll. K. Seyd, 1907).

Subfam. **Panesthiinae**.

Genus **Salganea**, Stål.

Salganea morio, Burm.

3 ♂♂, 2 ♀♀, Java (coll. Fritze).

Genus **Panesthia**, Serv.

Panesthia javanica, Serv.

1 ♂, 1 ♀, Java (coll. Fritze).

Panesthia australis, Br.

1 ♀, 1 larva, Australia (coll. Oderheimer).

Panesthia plagiata, Walk.

2 ♀♀, Ceylon (coll. Freudenberg).

Panesthia kheili, Bol.

1 ♀, Stephansort, German New Guinea (coll. A. Hoffmann, 1904). This is not typical as the tegmina are reduced to two lobes scarcely extending beyond the metanotum, but in all other details it agrees perfectly with Bolivar's description

I take this opportunity of describing two new species of Blattidae in the collection of the Zoological Museum of Berlin.

Periplaneta vosseleri, sp. n.

♂ Castaneous. Head piceous, labrum testaceous; antennae longer than the body, castaneous. Pronotum castaneous; with a sparse erect pubescence, no impressions, greatest width behind the middle, posterior margin obtusely angled. Angles of meso- and metanotum without membranous processes. Tegmina barely exceeding apex of abdomen. Supra-anal lamina quadrate, angles rounded; sub-genital lamina produced, posterior margin very convex, styles slender, long. Cerci long, lanceolate. Femora strongly armed; tarsi of usual type.

Total length 18 mm; length of tegmina 14 mm; pronotum 5 mm \times 6 mm.

Type in the Zoological Museum, Berlin.

Amani, German E. Africa (Vosseler).

Panchlora vosseleri, sp. n.

♀ Closely allied to *P. camerunensis*, Borg but differing in the following details. — Eyes touching. A very narrow submarginal black line on either side of the pronotum, a pair of black points in the anterior part of the pronotum. Tegmina with the following black points, one at the base of the anal vein, one at the point of divergence of radial from mediastinal vein, one in the discoidal field below the 2nd branch of the posterior ulnar vein, one between 5th and 6th costal veins, one at apex of tegmen below the anterior ulnar vein; a short black line below the radial vein, close to its base. Supra-anal lamina bilobate, exceeding the sub-genital lamina. Abdomen and legs pale testaceous.

Total length 25 mm; length of body 22 mm; length of tegmina 24 mm; pronotum 6.2 mm \times 8.6 mm.

Amani, German E. Africa (Vosseler).

Type in Zoological Museum, Berlin; co-type in Oxford University Museum.

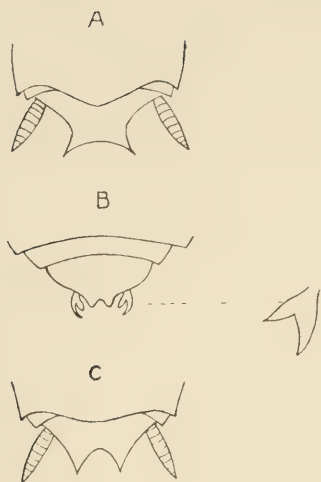


Fig. 1

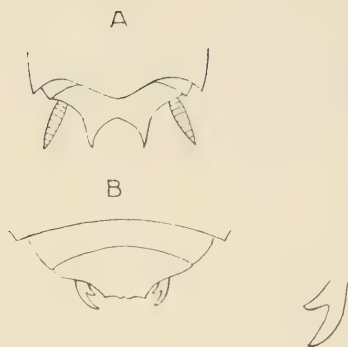


Fig. 2

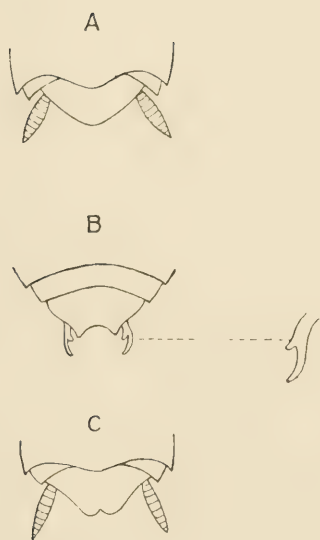


Fig. 3

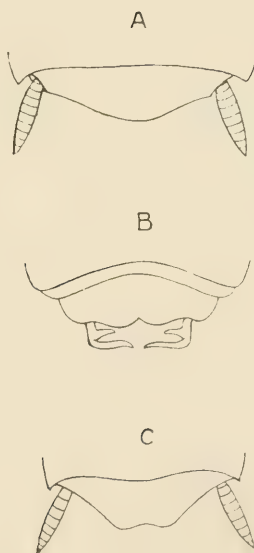


Fig. 4

Fig. 1. *Stylopyga furcifera* sp. n.

Fig. 3. *Stylopyga nigerrima* sp. n.

Fig. 2. *Stylopyga assimilis* sp. n.

Fig. 4. *Stylopyga manca*, Gerst.

A = supra-anal lamina, ♂.

B = sub-genital lamina, ♂.

C = supra-anal lamina ♀.

SOME NEW SPECIES OF BLATTIDÆ IN THE BRUSSELS MUSEUM

by **R. Shelford**, M. A.

THEGANOPTERYX CONGOENSIS, sp. n.

♂ ♀. Pale testaceous. Pronotum transversely elliptical, lateral margins broadly hyaline. Tegmina exceeding apex of abdomen, clear testaceous, marginal field broad, radial vein simple, 11 costals some bifurcate, 5 slender oblique discoidal sectors, posterior ulnar simple. Wings hyaline, mediastinal vein simple, 8 costals, their apices incrassated, ulnar vein bifurcate, apical triangle prominent. Supra-anal lamina, (♂) transversely trigonal, (♀) triangular, apex deeply cleft. Sub-genital lamina (♂) narrow, produced, exceeding the supra-anal lamina, 2 minute styles. (Cerci mutilated.) Front femora on anterior margin beneath with 3—4 strong spines succeeded by piliform setæ.

Total length ♂ 9,2 mill.; ♀ 9 mill.; length of body ♂ 8 mill., ♀ 7,5 mill.; length of tegmina ♂ 7 mill., ♀ 6,1 mill.; pronotum, $2 \times 3,3$ mill.

Congo State, Loango (WÆLBROECK), Luki, Mayumbe (ENGELBERT), Boma (TSCHOFFEN). Three examples.

One of the few testaceous species of the genus.

THEGANOPTERYX BANANÆ sp. n.

♂. Testaceous; disc of pronotum castaneous. Pronotum anteriorly parabolic, posteriorly truncate. Tegmina clear testaceous, scarcely exceeding apex of abdomen, venation as in preceding species. Wings hyaline, 7 costals, their apices not incrassated, joined at their bases by oblique venulæ, ulnar vein bifurcate. Supra-anal lamina trigonal, exceeded by the sub-genital lamina which is produced and strongly cucullate, styles minute. Cerci long, slender. Front femora as in preceding species.

♀. Similar to ♂ but pronotum broader, tegmina not exceeding apex of abdomen, with numerous minute quadrate castaneous maculæ between the veins. Wings rudimentary. Supra-anal lamina triangular, apex incised; sub-genital lamina semi-orbicular, ample.

Total length ♂ 9 mill., ♀ 7,9 mill.; length of body, 7,9 mill.;

length of tegmina ♂ 7 mill.; ♀ 5 mill.; pronotum ♂ 2×3 mill., ♀ 3×4 mill.

Congo State, Banana (F. BUSSCHODTS).

4 ♂♂, 1 ♀.

Allied to *T. congoensis* but distinguished by the marked sexual dimorphism, the different wing-venation and darker pronotum.

ISCHNOPTERA SORDIDA sp. n.

♂ and ♀. Sordid testaceous. A band between the eyes and some spots on the face castaneous. Pronotum with two castaneous blotches, irregular in shape, on the disc. Tegmina with radial vein bifurcate, 14 costals, 9 longitudinal discoidal sectors, anterior ulnar 3-ramose. Wings infuscated, mediastinal vein 5-ramose, radial vein bifurcate, 6-7 costals, ulnar vein 7-ramose, 4 of the rami being incomplete. Supra-anal lamina, (♂) produced, triangular, considerably exceeding the subgenital lamina, (♀) trigonal, apex deeply incised. Opening of scent glands in male, situated in 8th abdominal tergite. Subgenital lamina (♂) slightly asymmetrical, with two styles. Cerci moderately long. Front femora armed on anterior margin beneath with a complete row of spines, the distal shorter than the proximal.

Total length 16 mill.; length of body 12-13 mill.; length of tegmina 13 mill.; pronotum 4×5.2 mill.

Cameroons, Mundame Mungo (Oxford Museum, types), Mukonje Farm (Brussels Museum, a long series).

Allied to *I. punctifrons* GERST.

ISCHNOPTERA ROHDEI sp. n.

♂ and ♀. Above castaneous, lateral margins of pronotum and of tegmina at base testaceo hyaline. Head testaceous, vertex and some maculae on the face castaneous; antennae castaneous, except at base. Disc of pronotum with paler castaneous suffusion, inner border of testaceous margin sinuate, anterior margin narrowly flavo-testaceous. Tegmina exceeding apex of abdomen, radial vein bifurcate, 17 costals, 9 longitudinal discoidal sectors, anterior ulnar 3-ramose. Wings infuscated, mediastinal vein multiramose, radial bifurcate, 10 costals, ulnar vein with 7 rami, 2 being incomplete. Supra anal lamina, (♂) trigonal with scent gland opening at base, apex slightly incised, (♀) trigonal, apex slightly incised. Subgenital lamina (♂) rotundate, symmetrical, with 2 short styles situated in

small notches in the posterior border, the styles are beset with minute spines, the right is a little shorter than the left. Cerci slender. Body beneath and legs rufo testaceous. Front femora with long spines succeeded distally by shorter. Total length 27 mill.; length of body 11 (♀) — 12 (♂) mill.; length of tegmina 13 mill.; pronotum 3,1 mill. \times 4,6 mill.

Cameroons, Mukonje Farm (H. ROHDE) 1 ♂, 2 ♀♀.

This belongs to the group including *I. cinnamomea*, GERST., *I. punctifrons* GERST. etc. but is distinguished by the form of the supra-anal lamina in the ♂; the nearest ally of the species appears to *I. bimaculata*. GERST.

ISCHNOPTERA CRURALIS sp. n.

♂ and ♀. Piceous, nitid. Antennæ bright rufous except at base. Pronotum barely covering vertex of head, posteriorly rounded, sides deflexed, a pair of shallow oblique impressions. Tegmina considerably exceeding apex of abdomen, 14–16 costals, radial vein bifurcate in posterior third. 9 longitudinal discoidal sectors, anterior ulnar tri-ramose, 5–7 costals, ulnar vein with 10 rami, 4 being incomplete. Opening of scent-gland (♂) on 1st abdominal tergite; supra anal lamina (♂) produced, sub quadrate, posterior angles rounded, (♀) narrow, trigonal. Abdomen beneath with the apex rufescent, apex piceous; sub-genital lamina, (♂) produced, asymmetrical, the apex pointed and together with the single (left) style clothed with stout bristles, (♀) ample, semiorbicular. Cerci orange. Legs piceous, the tibiae, except at base and apex, orange, front femora with a complete row of spines on anterior margin beneath, the more distal the shorter.

♂ Total length 21,5 mill.; length of tegmina 17,2 mill.; length of body 17 mill.; pronotum 4,7 mill. \times 5 mill.

♀ Total length 27,5 mill.; length of tegmina 22,1 mill.; length of body 20,5 mill.; pronotum 6,1 mill. \times 7,2 mill.

Cameroons. ♂ Type in Brussels Museum. ♀ Type in Oxford Museum.

The is quite different from all the known African species of *Ischnoptera* and is more closely allied to some of the larger Oriental species.

The African species of *Ischnoptera* can be distinguished as far as the males are concerned by the following key. The females resemble each other very closely and present practically no characters of importance in specific diagnoses, it is consequently impossible to draw up a really reliable key to their identification especially as

I have been unable to examine all of the type specimens. The description of new species of *Ischnoptera* from female examples is strongly to be deprecated.

KEY TO AFRICAN SPECIES OF *ISCHNOPTERA*.



1. Species of large size (exceeding 18 mill. in total length), legs bicolorous *I. cruralis* sp. n. (Cameroons)
- 1'. Species of smaller size (not exceeding 18 mill. in total length), legs unicolorous.
 2. Pronotum black with 3 discoidal rufous spots *I. Bocagei* BOL. (Angola).
 - 2'. Pronotum not as above.
 3. Unicolorous piceous species *I. picea* SCHULTH. (Somali-land).
 - 3'. Not unicolorous piceous species.
 4. Scent-gland opening at base of supra-anal lamina.
 5. A pair of backwardly-directed chitinous processes from beneath the 6th abdominal tergite *I. cinnamomea* GERST.
[= *basalis* GERST.] (Cameroons).
 - 5'. No backwardly-directed chitinous processes.
 6. Subgenital lamina symmetrical *I. Rohdei* sp. n. (Cameroons).
 - 6'. Sub-genital lamina asymmetrical. *I. bimaculata* GERST.
(German E. Africa).
 - 4'. Scent-glands not opening at base of supra-anal lamina.
 5. Sub-genital lamina very asymmetrical.
 6. With only one genital style.
 7. Style slender (fulvo-testaceous species) *I. malagassa* SAUSS. & ZEHNT.
(Madagascar).
 - 7'. Style robust (castaneous species) *I. natalensis* WALK. (Natal).
 - 6'. With two styles *I. strigosa* SCHAUW.
[? = *incuriosa* SAUSS.]
(E. Africa).
- 5'. Sub-genital lamina less asymmetrical, with two styles.
 6. Supra-anal lamina produced, considerably exceeding sub-genital lamina.
 7. Supra-anal lamina sub-quadrangular (fulvo-testaceous species, pronotum im-maculate) *I. relucens* GERST. (Cameroons).
 - 7'. Supra-anal lamina triangular (sordid testaceous species, pronotum indistinctly bi-maculate) *I. sordida* sp. n. (Cameroons).

- 6'. Supra-anal lamina not produced,
not or scarcely exceeding the
sub-genital lamina.
7. Pronotum bi-maculate; supra-
anal lamina slightly exceeding
the sub-genital lamina . . . *I. Longstaffi* SHELF. (Zambesi).
- 7'. Pronotum not bi-maculate; su-
pra-anal lamina exceeding
the sub-genital lamina. . . *I. punctifrons* GERST.
[= *ægrola* GERST.]
(Cameroons).

♀♀

1. Species of large size (exceeding 18 mill. in
total length), legs bicolorous. *I. cruralis* sp. n.
- 1'. Species of smaller size (not exceeding 18 mill.
in total length), legs not bicolorous.
2. Apex of supra-anal lamina incised.
3. Supra-anal lamina with acute median
carina. *I. jallæ* GIG.-TOS (Upper Zam-
[besi]).
- 3'. Supra-anal lamina without acute median
carina.
4. Pronotum bimaculate { *I. bimaculata* GERST.
and
I. sordida sp. n.
- 4'. Pronotum not bimaculate.
5. Pronotum rufescent, paler than teg-
mina. *I. cinnamomea* GERST.
- 5'. Pronotum castaneous, unicolorous
with tegmina. *I. Rohdei* sp. n.
- 2'. Apex of supra-anal lamina not incised.
3. Supra-anal lamina produced, triangular. *I. malagassa* SAUSS. & ZEHNT.
- 3'. Supra-anal lamina produced, trigonal.
4. Pronotum bimaculate *I. Longstaffi* SHELF.
- 4'. Pronotum not bimaculate.
5. Wings with apical triangular area . . . *I. neutra* SAUSS. (E. Africa).
- 5'. Wings without apical triangular area.
6. Sordid testaceous species. *I. punctifrons* GERST.
I. relucens GERST.
and
I. strigosa SCHAUM.
[? = *incuriosa* SAUSS.].
- 6'. Rufous species {

PHYLLODROMIA SEVERINI sp. n.

♂, ♀. Rufo-testaceous. Antennæ fuscous, except at base, where they are testaceous. Eyes and antennal sockets equally far apart. Pronotum transversely elliptical, laterally hyaline. Tegmina clear flavo-hyaline, considerably exceeding apex of abdomen, veins very slender, marginal field moderately broad, 11 costals, some being

ramose, 5 oblique discoidal sectors, posterior ulnar simple, discoidal field reticulated. Wings hyaline, veins flavid, mediastinal vein multiramosa, 9-11 costals, ulnar vein 6-ramose, no triangular apical area. Supra-anal lamina, (♂) shortly produced, triangular, exceeded by the subgenital lamina, (♀) short transverse. No scent-gland openings visible in the ♂. Subgenital lamina (♂) shortly produced, apex cleft, a strong median carina and a deep fold on either side of this; styles short, acuminate, directed downwards. Cerci long, slender, 11-jointed. Front femora armed on anterior margin beneath with piliform setae, not extending to basal third of margin. Formula of apical spines 3 1, 1 1, 1 1. Ootheca chitinous, carried with the suture uppermost.

Total length 14,5-15,5 mill.; length of body 12 mill.; tegmina 12 mill.; pronotum 3×5 mill.

Cameroons, Mukonje Farm (H. ROHDE), 2 ♂♂, 1 ♀.

Nearest to *P. translucida* mihi. The form of the subgenital lamina is as in *Temnopteryx ectobioides*, mihi.

I have much pleasure in naming this species after M. G. SEVERIN to whom I am indebted for the opportunity of examining the interesting collection of Blattidae in the Brussels Museum.

PHYLLODROMIA CAMERUNENSIS sp. n.

♀. Castaneous. Head rufous, antennae piceous, eyes rather wide apart. Pronotum transversely elliptical, lateral margins widely, posterior margin narrowly, testaceous hyaline. Tegmina uniform castaneous, considerably exceeding the apex of the abdomen, lanceolate; marginal field rather broad, radial vein with apex ramose. 10 costals, the last 2 ramose, 6-7 oblique discoidal sectors, posterior ulnar simple. Wings infuscated, mediastinal vein ramose, 5 costals, the last 2 ramose, ulnar vein with 5 rami. Abdomen piceous above, rufous below. Supra-anal lamina trigonal, apex produced and deeply cleft, forming two narrow hirsute lobes. Subgenital lamina semi orbicular, ample, carinate near apex, posterior margin slightly incised in the middle. Cerci moderately long, slender, acuminate. Coxae testaceous or rufo-castaneous; femora rufo-castaneous or castaneous; tibiae darker. Front femora on anterior margin beneath with piliform setae only. Formula of apical spines 2 1, 1 1, 1 1.

Total length 17 mill.; length of body 13 mill.; length of tegmina 15 mill.; pronotum $3,5 \times 5,5$.

Cameroons, Mukonje Farm (H. ROHDE). Two examples.

PHYLLODROMIA STOLIDA sp. n.

♂, ♀. Sordid testaceous. Vertex and front with castaneous bands. Pronotum trapezoidal, lateral margins hyaline, disc with traces of darker markings. Tegmina exceeding apex of abdomen, radial vein simple, 11 costals, last 2 or 3 ramose, 4 longitudinal discoidal sectors, posterior ulnar simple. Wings hyaline, mediastinal and radial veins simple, 10 costals, their apices incrassated, last 3 bifurcate, ulnar vein tri-ramose, triangular apical area insignificant. Abdomen above and beneath bordered all round with castaneous. Supra-anal lamina, (♂) trigonal, apex entire, (♀) transverse. Sub-genital lamina (♂) not much produced, with two slender styles. Cerci moderate, tipped with castaneous. Front femora armed on anterior margin beneath with 3—4 spines succeeded by piliform setæ.

Total length 10 mill.; length of body 7,5 mill.; length of tegmina 8,2 mill.; pronotum 2×3 mill.

Congo State, Kinchassa (WÆLBROECK). Two examples.

Allied to *P. hemerobina* GERST.

LIOSILPHA BRUNNEA sp. n.

♀. Castaneous. Head piceous. Antennæ longer than body. Eyes wide apart. Maxillary palpi with 2nd and 3d joints subequal, 4th joint only a little shorter. Pronotum scarcely covering vertex of head, sides not so much deflexed as is usual in this genus, lateral margins flavo-hyaline but not extending to posterior angles, disc with rufous suffusions. Tegmina castaneous, mediastinal field hyaline, barely exceeding apex of abdomen, broad, overlapping strongly, of equal breadth throughout, apex blunt, rounded; marginal field equal in length to discoidal field, mediastinal vein bi-ramose, radial vein not bifurcate, apex ramose, 10 costals, the last 3 ramose, 8 more or less oblique discoidal sectors, posterior ulnar 3-ramose. Wings infuscated, mediastinal vein bi-ramose, 8 costals, ulnar vein with 6 rami. Supra-anal lamina trigonal, apex slightly incised. Cerci very long, almost as long as the posterior tibiae. Coxæ and femora blotched with testaceous, femora piceous, tibiae and tarsi castaneous. Front femora on anterior margin beneath with a row of close-set spines beginning in the middle third of the margin and not extending quite to the apex.

Total length 20 mill.; length of body 17,8 mill.; length of tegmina 16 mill.; pronotum $5,5 \text{ mill.} \times 7,5 \text{ mill.}$

Cameroons, Mukonje Farm (H. ROHDE). One example.

A very distinct species, more depressed than usual in this genus.

METHANA PAPUA sp. n.

Head testaceous, the frons and a broad band down the centre of the face piceous. Labrum bilobate; antennae castaneous. Pronotum piceous, nitid, margined all round with flavid. Tegmina castaneous, nitid, laterally margined with flavid, not extending far beyond the apex of the abdomen. Abdomen piceous, margined above and beneath with flavid.

Supra-anal lamina. (♂) sub-quadrate, apex emarginate, (♀) trigonal, produced, cucullate, apex truncate and emarginate, posterior angles acute.

Sub-genital lamina (♂) sub-quadrate. Cerci elongate. Coxae and femora testaceous, tibiae and tarsi castaneous.

Total length 27—28.5 mill.; length of body 24—25.5 mill.; length of tegmina 21—22.5 mill.; pronotum 8.1 mill. \times 9.3 mill.

British New Guinea, Astrolabe district (♂ type in Genoa Museum, ♀ type in Brussels Museum).

Allied to *M. marginalis* Sauss. but larger and with the pronotum margined all round. The bilobate labrum is characteristic of the Australasian species of the genus.

PSEUDODEROPELTIS PRORSA sp. n.

♂. Rufo-testaceous. Vertex and frons castaneous. Pronotum castaneous, lateral margins broadly testaceous and a narrow sagittate marking on the median line of the disc. Tegmina and wings rufo-testaceous, considerably exceeding apex of abdomen. Meso- and metanotum with the characteristic membranous processes.

Supra-anal lamina quadrate, depressed in the middle, apex emarginate and fimbriate. Cerci rather short, castaneous. Front femora with a complete row of spines on the anterior margin beneath.

Total length 27.6 mill.; length of body 20 mill.; length of tegmina 23 mill.; pronotum 5 mill. \times 6.1 mill.

Congo. One example.

GYNA JOCOSA sp. n.

♂. Distance of eyes apart equal to breadth of 1st antennal joint. Head castaneous, vertex and mouth-parts testaceous, frons concave and transversely striate. Antennae castaneous. Pronotum rufo-castaneous, margined all round with flavid, broadest laterally,

narrowest posteriorly; posterior half transversely striate. Tegmina with basal two fifths castaneous, apical three fifths testaceous with a large castaneous spot near the apex of the margin; the line of demarcation between these two coloured areas is V-shaped and finely dentate. Abdomen and legs orange. Supra-anal lamina sub-quadrangular, sub-genital lamina asymmetrical, styles minute. Cerci pointed, orange.

Total length 16 mill.; length of body 12,7 mill.; length of tegmina 14 mill.; pronotum 4,3 mill. \times 5,2 mill.

Bena Bendi, Sankuru River (L. CLOETENS), Popocabacca (F. LOOS).

Congo Free State. Two examples. Allied to *G. gloriosa* STÅL but smaller and differently coloured.

NAUPHETA SORDIDA sp. n.

♀. Dull sordid testaceous. Antennæ fuscous, eyes wide apart. Pronotum uniformly coloured with a few scattered fuscous points, some larger ones arranged round the margin. Tegmina not exceeding the apex of the abdomen by much, uniformly sordid testaceous with scattered black points, the extreme base of the radial vein piceous, mediastinal area rather narrow. Abdomen dull pale castaneous, supra-anal lamina bilobed. Legs dull testaceous spotted with castaneous points.

Total length 31 mill.; length of body 27,3 mill.; length of tegmina 24 mill.; pronotum 7 mill. \times 9,8 mill.

Cameroons, Mukonje Farm (R. ROHDE). Two examples.

This dull-coloured species presents a great contrast to the bright testaceous species so characteristic of West-Africa; its nearest ally appears to be *N. heydeniana* SAUSS. & ZEHNT. from Madagascar, but that species has the tegmina shorter and is not spotted with black points, the tegmina also are more convex.

STILPNOBLATTA MINUTISSIMA sp. n.

♀. Dark castaneous, nitid, minutely and obscurely punctate. Eyes and antennal sockets equally far apart. Antennæ castaneous at base, fuscous in the middle, apical 3 joints testaceous. Pronotum not covering vertex of head. Tegmina squamiform, broader than long, scarcely exceeding the mesonotum, punctate, radial vein represented by an obtuse carina. Supra-anal lamina produced, rotundate, apex not emarginate, exceeded by the sub-genital lamina which is semi-orbicular, ample. Cerci very short and blunt, their jointing obscured.

Legs short, rufo-castaneous. Tarsi without arolia between the claws.

Length 8 mill. : length of tegmina 1.6 mill. : pronotum 2.8 mill. \times 3.9 mill.

Gango State, Umangi (E. WILVENTH, Sept-Nov. 1906). Three examples.

The genus is new to Africa, the only other species known, *S. bengalensis*, SAUSS., occurring in India and Cochin China. The African species is distinguished by its very small size.

SALGANEA PAPUA sp. n.

2. Piceous, of large size. Pronotum anteriorly with a wide deep emargination, the angles of this upwardly and backwardly produced to form two hooked processes. Anterior part of pronotum depressed, granulate, with two curved oblique sulci. Six small tubercles arranged semiregularly across the pronotum immediately behind the depressed area. Tegmina and wings considerably exceeding the apex of the abdomen, generally much mutilated or amputated. The first 5 abdominal tergites faintly punctate, the remainder deeply cribrate-punctate. Lateral margins of 7th tergite straight, dentate, posterior angles produced, an oblique depressed scar on either side of the disc of this tergite. Margin of supra-anal lamina finely and regularly dentate, a large blunt tooth on either side at the base. Cerci short, conical. Ventral surface more sparsely punctate than dorsal surface. Front femora with two spines on anterior margin beneath.

Total length 75 mill. : length of body 60-67 mill. : length of tegmina 63 mill. : pronotum 14 mill. \times 24 mill.

German New-Guinea, Sattelberg (Oxford Mus. Type) : British New Guinea (Oxford Mus. and Melbourne Mus.) : Astrolabe Bay (Brussels Mus.).

The largest species of the genus and one of the largest of the sub-family.

Descriptions of some new genera and species of *Blattidae*. (Orth.)

By **R. Shelford**, Oxford.

The majority of the species described in this paper are contained in the Hope collection, Oxford University Museum and unless otherwise stated the type-specimens are deposited in this collection. The University Museum is indebted to the firm of Staudinger and Bang-Haas for the generous donation of several new species, most of which are now described.

Sub-fam. *Ectobiinae*.

Anaplecta bolivari sp. n.

♀. Castaneous. Head and pronotum rufo-testaceous. Tegmina with marginal area narrow, 9 costals, 4 longitudinal discoidal sectors. Wings infuscated, radial vein bifurcate from base, 7 costals, median vein obsolete at base, apex curved up to meet the radial vein, medio-discal area crossed by 2 transverse venules, 1st axillary 4-ramose, apical triangle less than $\frac{1}{2}$ of total wing-length, base straight. Abdomen beneath and legs testaceous. Supra-anal lamina trigonal, subgenital lamina deeply cleft. Total length 6 mm; length of tegmina 5 mm.

Kamerun (coll. Bolivar, type).

The West-African species of the genus can be distinguished as follows:

1. Pronotum unicolorous
2. Pronotum and tegmina concolorous
 3. Tegmina with outer margin testaceous *A. cincta*, Gerst.
 - 3'. Tegmina unicolorous
 4. Castaneous species *A. dahomensis* Shelf.
 - 4'. Flavo-testaceous species *A. pulchra* Shelf.
 - 2'. Pronotum paler than tegmina *A. bolivari* Shelf.
 - 1'. Pronotum with fuscous vittae *A. conradti* Shelf.

Anaplectoidea modesta sp. n.

♂. Testaceous. Disc of pronotum castaneous, lateral margins broadly hyaline. Tegmina clear testaceous, 14 costals, 6 or 7 oblique discoidal sectors, anal vein impressed, axillaries obsolescent. Wings with veins and reflected apical area castaneous, 9—10 costals, medio-discal area 4 times broader than medio-ulnar, crossed by 5 transverse venules, ulnar vein 3-ramose, 1st axillary vein 4-ramose, apical area $\frac{3}{8}$ of total wing-length. Abdomen beneath picous at base, castaneous at apex, sub-genital

lamina produced, symmetrical, with a pair of slender styles. Cerci castaneous. Legs testaceous.

Total length 7 mm; length of body 6 mm; length of tegmina 5 mm; pronotum $1,8 \times 2,4$ mm.

Ceylon, Wellawaya.

Anaplectoidea notata sp. n.

♂. Testaceous. Disc of pronotum castaneous with hyaline lateral margins. Tegmina with base of radial vein, bases of anal and discoidal fields castaneous, a clear spot in centre of anal field, rest of tegmina testaceous; marginal field broad, 15 costals, 9 oblique discoidal sectors, anal vein impressed, axillaries obsolescent. Wings with 14 costals, their apices incrassated, marginal field dilated, medio-discal area about 3 times broader than medio-ulnar, crossed by 10 transverse venules, ulnar vein 4-ramose, 1st axillary vein 4-ramose, apical area about $\frac{1}{4}$ total wing-length, acutely angled at base, apex obtusely rounded, emarginate. Supra-anal lamina trigonal, exceeded by the subgenital lamina which is produced and is provided with two styles.

Total length 8 mm; length of body 6,9 mm; length of tegmina 6,5 mm; pronotum $1,8 \times 2,6$ mm.

Annam, Phuc Son.

The four species of *Anaplectoidea* can be distinguished by the following key:

1. Tegmina unicolorous
 2. Apical area of wing broader than long or as broad as long.
 3. Wings suffused with castaneous . . . *A. nitida* Shelf.
(Batjan & Celebes)
 - 3'. Wings flavid *A. dohertyi* Shelf.
(Sangir)
 - 2'. Apical area of wing longer than broad *A. modesta* sp. n.
- 1'. Tegmina not unicolorous *A. notata* sp. n.

Sub-fam. *Phyllodromiinae*.

Pseudothyrsocera bicolor sp. n.

♂. Head piceous. Antennae with the basal two-thirds piceous and plumose, apical third setaceous, ochreous. Pronotum piceous, smooth, trapezoidal. Tegmina piceous at base and apex, intermediate area flavo-testaceous with a small fuscous macula in the middle, an elongate hyaline spot in the mediastinal field; 7 longitudinal discoidal sectors, anterior ulnar vein 3-ramose. Wings with extreme base and apex infuscated, remainder hyaline, veins of posterior part piceous, mediastinal vein 3-ramose, 8 costals,

the first 3 and the mediastinal rami lengthily incrassated, ulnar vein 5-ramose. Abdomen above and beneath piceous; 1st tergite with a scent-gland opening; supra-anal lamina trigonal but produced in the centre to form a rounded median lobe, surpassed by the subgenital lamina which is produced, almost symmetrical; the leftstyle stout, almost median in position, much longer than the minute right style. Coxae with their apical halves and their outer margins testaceous, the remainder of the legs piceous.

Total length 17,2 mm; length of body 12,5 mm; length of tegmina 13 mm; pronotum $5 \times 5,6$ mm.

Borneo, Sarawak, Mt. Matang.

Phyllodromia phryne sp. n.

♂. Head ochreous; eyes, antennae and maxillary palpi piceous. Pronotum bright ochreous, discoidal, not nearly covering vertex of head; scutellum hidden. Tegmina and wings extending considerably beyond apex of abdomen. Tegmina ochreous, anal field, apex and a broad discoidal streak fusco-castaneous; marginal field broad, radial vein bifurcate at apex, 13 costals the last multiramosa, anterior ulnar multiramosa, posterior ulnar simple, discoidal sectors more or less longitudinal. Wings flavid, apex infuscated, an ochreous stigma formed by the incrassated apices of some of the costals, 9 costals, the first 6 incrassated, mediastinal vein simple, ulnar vein 5-ramose, an inconspicuous apical triangle. Abdomen short, ochreous, 8th and 9th tergite almost completely concealed beneath the 7th, posterior margin of 9th tergite notched, supra-anal lamina shortly trigonal; sub-genital lamina rather large, produced, symmetrical, with a pair of slender styles near the middle of the posterior margin. Cerci ochreous, long and slender, 10-jointed. Legs ochreous with the fore- and mid-tibiae, the genicula of all the femora, the apex of the hind-tibiae and all the tarsi, piceous. Front femora with 2—3 spines on the anterior margin beneath, succeeded distally by piliform setae; the other femora strongly armed. Genicular spines long.

Total length 12,8 mm; length of body 8,9 mm; length of tegmina 10 mm; pronotum $3 \times 3,4$ mm.

Kamerun (coll. Bolivar, type).

One of the most brilliantly coloured species of the genus.

Phyllodromia bolivari sp. n.

♂. Head castaneous, frons and vertex rugose-punctate. Eyes wide apart. Antennae fuscous with two basal joints testaceous, clothed with an erect rufous pubescence. Pronotum discoidal, not covering vertex of head, sparsely rufo-fimbriate, disc rufescent,

margins castaneous. Tegmina and wings exceeding the apex of the abdomen. Tegmina castaneous, mediastinal vein 3-ramose, radial bifurcate, the lower branch multiramose, 7—8 costals, anterior ulnar simple, 5 longitudinal discoidal sectors. Wings castaneous, anterior part extending beyond the posterior part considerably, no trace of a triangular apical area, radial vein bifurcate from near the base, 7—8 costals, ulnar vein 3-ramose, 1st axillary 4-ramose. Abdomen and legs rufo-testaceous; supra-anal lamina short, transverse, posteriorly emarginate, exceeded by the sub-genital lamina which is symmetrical with 2 minute styles placed to the left of the middle line. Cerci slender (mutilated). Legs moderately armed; front femora with 3 spines on anterior margin beneath, succeeded distally by piliform setae. Genicular and apical spines normal. Tarsal arolia present.

Total length 9,2 mm; length of body 7,5 mm; length of tegmina 7 mm; pronotum $2 \times 2,5$ mm.

Kamerun (coll. Bolívar).

A curious little species, superficially resembling a *Latindia*.

Phyllodromia denticulata sp. n.

♂. Castaneous. Disc of pronotum castaneous with a rufous macula, lateral margins hyaline. Tegmina castaneo-hyaline, lateral margin hyaline; radial vein bifurcate from near base, 15 costals, anterior ulnar 4-ramose, posterior ulnar 3-ramose. Wings suffused with castaneous, mediastinal vein bi-ramose, the rami incrassate, 12 costals, all but the last two or three incrassate, ulnar vein 3-ramose, a small triangular apical area. Abdomen above rufo-castaneous; supra-anal lamina shortly produced, exceeded by the sub-genital lamina, its apex truncate, the posterior angles armed with a bifurcate spine; sub-genital lamina asymmetrical, the left style short and blunt, the right style situated at the apex of the lamina broader than long and armed with numerous minute spines. Cerci moderate. Legs testaceous, front femora armed on anterior margin beneath with 3—4 long spines succeeded distally by piliform setae.

Total length 12,2 mm; length of body 10 mm; length of tegmina 10 mm; pronotum $2,5 \times 3$ mm.

Peru, Callanga.

A remarkable species on account of the armature of the apical abdominal segment.

Phyllodromia inconspicua sp. n.

♂. Uniform pale testaceous. Pronotum with lateral hyaline margins. Tegmina considerably exceeding the apex of the ab-

domen, in some specimens with a few scattered fuscous points; radial vein bifurcate, 10—11 costals, 5 oblique discoidal sectors, posterior ulnar simple. Wings hyaline, costal margin faintly suffused with castaneous, mediastinal vein bifurcate, 7 costals, the last 2 ramose, the first 4 clavate, ulnar vein ramose, triangular apical area minute. Supra-anal lamina shortly trigonal, sub-genital lamina exceeding it, apex slightly produced, excised, a pair of short blunt styles, their apices minutely denticulate dorsally. Cerci long, slender, fuscous beneath. Front femora completely armed on the anterior margin beneath, the distal spines the shorter.

Total length 14 mm; length of body 11 mm; length of tegmina 12 mm; pronotum $3,5 \times 4$ mm.

Brazil, Rio Grande do Sul.

Two examples in the Oxford University Museum labelled by Brunner "*Phyllodromia* sp. n."

Phyllodromia maculiventris sp. n.

♂. Testaceous. Frons obscurely marked with castaneous dots and lines. Pronotum transversely elliptical, margins broadly hyaline, disc with symmetrical liturate markings. Tegmina barely exceeding the apex of the abdomen, testaceo-hyaline, the veins rufescent; about 10 costals, many ramose, radial simple, 5 discoidal sectors, posterior ulnar simple, numerous transverse venules which are fuscous. Wings faintly suffused with flavo-testaceous, 9 costals, the first 6 strongly clavate, ulnar 4-ramose. Abdomen above blotched with castaneous, the last 3 tergites constricted, supra-anal lamina short, transverse. Abdomen beneath testaceous with a large piceous macula on sternites 1—6, sub-genital lamina large, produced, considerably exceeding the supra-anal plate, its apex slightly emarginate, styles slender, situated in deep notches on either side of the apex, some stiff, erect hairs at their points of insertion. Cerci rather short, flattened, outwardly curved. Front femora with a complete row of spines on the anterior margin beneath.

♀. Similar; supra-anal lamina with the apex emarginate, sub-genital lamina semi-orbicular, ample.

Total length (♂) 17,5 mm, (♀) 15,5 mm; length of body (♂) 17 mm, (♀) 13 mm; length of tegmina (♂) 14 mm, (♀) 12,9 mm; pronotum $3 \times 4,2$ mm.

Bolivia, Mapiro; Peru, Callanga.

Readily distinguished by the heavily marked abdomen.

Phyllodromia flora sp. n.

♂ ♀. Allied to the preceding species, but smaller, the tegmina relatively longer, sub-genital lamina (♂) with the apex less produced and the styles much smaller, cerci very long, their apices acuminate.

Total length (♂) 15,6 mm, (♀) 15 mm; length of body (♂) 12 mm, (♀) 12 mm; length of tegmina (♂) 13 mm, (♀) 12 mm; pronotum $3 \times 3,9$ mm.

Peru, Callanga.

Phyllodromia peruana sp. n.

♂. Testaceo-hyaline. Pronotum transversely elliptical, lateral margins broadly hyaline, disc immaculate or with very faint brown streaks. Tegmina extending considerably beyond the apex of the abdomen, 10 costals, the 9th multiramose, 5 longitudinal discoidal sectors, posterior ulnar simple, discoidal field reticulated. Wings hyaline, veins faintly castaneous, mediastinal 3-ramose, 7 costals, the last 3 multiramose, the first 4 and the mediastinal rami clavate, ulnar vein 4-ramose, an inconspicuous apical triangle. Supra-anal lamina shortly trigonal. Abdomen beneath with large central maculae on the basal sternites and small lateral maculae on all the sternites; sub-genital lamina, produced, asymmetrical, apex widely emarginate, the left posterior angle dentiform, a pair of stout styles in the apical emargination, almost touching at their bases. Cerci long and slender. Front femora completely armed beneath, the more distal spines shorter.

Total length 14,5 mm; length of body 11,5 mm; length of tegmina 12,2 mm; pronotum 3×4 mm.

A species that might be placed almost equally well in the genus *Pseudectobia* as defined by Saussure and Zehntner.

Peru, Callanga.

Phyllodromia dido sp. n.

♂. Castaneous. Frons and face testaceous with 3 castaneous transverse bands. Pronotum trapezoidal, disc with a large castaneous macula extending from anterior to posterior margin, lateral margins broadly hyaline. Tegmina castaneo-hyaline, the colour deepest along the course of the radial and anal veins, costal margin hyaline; 11 costals, the last 2 ramose, radial bifurcate near apex, 6 longitudinal discoidal sectors, numerous transverse venulae, posterior ulnar simple. Wings castaneous, mediastinal vein 4-ramose, radial vein bifurcate, apex ramose, 10 costals, the more proximal clavate, ulnar with 5 ramose branches. Tegmina and wings considerably exceeding apex of abdomen.

Abdomen castaneous, supra-anal lamina trigonal, not exceeding the sub-genital lamina which at the apex is squarely emarginate; no genital styles. Abdomen beneath with the disc paler. Cerci very long, 3 apical joints slender. Legs sordid testaceous, front femora with a complete row of spines on the anterior margin beneath, the more proximal spines shorter.

Total length 16 mm; length of body 13 mm; length of tegmina 14 mm; pronotum 3×3.9 mm.

Bolivia, Mapiri.

The nearest ally of this species is *P. pallipes* Scudder from Peru, but that differs in the colouration of the head and wings.

Pseudophyllodromia boliviensis sp. n.

♂ ♀. Short and broad. Head bright rufous with the face orange. Antennae not exceeding the body in length, incrassate, piceous with a broad testaceous band near the apex. Pronotum transversely elliptical, posteriorly very slightly produced, lateral margins broadly hyaline, disc piceous with 4 testaceous maculae, a median elongate one in the anterior half of the disc, a median small one on the posterior margin and two on either side of the middle line in the centre of the disc. Scutellum with a testaceous spot. Tegmina castaneous, marginal field, the greater part of the anal field and the base of the discoidal field hyaline, 11 costals, radial bifurcate near apex and its lower ramus multiramose, 3 discoidal sectors, anterior ulnar biramose, base of posterior ulnar obsolescent, venae spuriae between the sectors and numerous transverse venulae. Wings castaneo-hyaline, marginal area near apex flavo-testaceous, 10 costals, ulnar 3-ramose. Abdomen beneath flavo-testaceous, castaneous at base, sub-genital lamina (♂) shortly produced, with a pair of thick blunt styles, (♀) with a castaneous blotch, semi-orbicular, ample, apex cleft. Cerci moderate, apex acuminate. Legs testaceous, front femora with 3—4 long spines on anterior margin beneath, succeeded distally by piliform setae.

Total length 10—12 mm; length of body 9—11 mm; length of tegmina 8—9 mm; pronotum 3×4 mm.

Bolivia, Mapiri.

Distinguished by the incrassate antennae and pronotal pattern.

Pseudophyllodromia albomaculata sp. n.

♂. Head piceous, vertex castaneous, a narrow white line across the frons between the lower part of the eyes, some spots on the face and the apex of the clypeus flavid. Antennae very slender, fuscous. Pronotum sub-trapezoidal, rather strongly pro-

duced backwards, anteriorly truncate: disc with a large castaneous cordiform macula, all the margins testaceo-hyaline. Tegmina castaneous with the mediastinal area and numerous minute maculae testaceous; 15 costals, anterior ulnar vein with 4 longitudinal rami, posterior ulnar simple. Wings infuscated, 10 costals, the distal 4 bifurcate, ulnar vein 4-ramose, a distinct apical triangle. Abdomen above and beneath piceous. Supra-anal lamina trigonal. Cerci moderate, highly acuminate at apex. Legs piceous, tarsi testaceous at base.

Total length 11,2 mm; length of tegmina 8 mm; pronotum $2,9 \times 3,9$ mm.

Peru, Callanga.

Probably the nearest ally of this species is *P. obscura* Sauss. but the backward production of the pronotum and the apical triangle of the wing are unusual features in this genus.

Sub-fam. *Blattinae*.

Paramethana buyssoni sp. n.

♂. Head and antennae piceous, ocelli and a band between the eyes ochreous, mouth-parts rufo-castaneous. Pronotum trapezoidal, anteriorly not covering vertex of head, bright ochreous with a large sub-cordiform piceous macula occupying the centre of the disc. Tegmina semi-corneous barely exceeding apex of abdomen, castaneous, densely reticulate-punctate. Wings as long as tegmina, anterior part semi-corneous with rounded apex, posterior part somewhat reduced. Metanotum with a quadrangular membranous flap attached to the middle of the posterior margin. Abdomen piceous, supra-anal lamina quadrangular faintly emarginate, exceeded by the sub-genital lamina which is quadrangular, posterior angles acute, styles stout, lateral. Cerci rather short and blunt. Coxae and femora rufous, tibiae and tarsi piceous. Femoral spines short and rather weak, tibial spines long and stronger, the innermost apical calcar on the outer aspect of the posterior tibiae almost as long as the metatarsus. Posterior metatarsus shorter than remaining joints, bi-seriately spined beneath, pulvilli very large.

♀. Similar, but discoidal macula of the pronotum much larger. Tegmina very short, concavely and obliquely truncate, not extending beyond the 1st abdominal tergite. Wings rudimentary. The first 3 abdominal tergites banded with ochreous, some small maculae of the same colour on the 4th tergite. Dorsum of abdomen rugose, posterior angles of 5th — 7th tergites spinously produced, supra-anal lamina triangular, apex notched, exceeding

the cerci which are short and rounded at the apex. Legs uniform piceous, stouter than in the ♂, calcar of posterior tibia as long as the metatarsus which is short.

Total length (♂) 27 mm; length of body (♂) 25 mm, (♀) 25,9 mm; length of tegmina (♂) 19,5 mm, (♀) 7 mm; pronotum $7 \times 9,6$ mm.

German East Africa, Dar-es-Salaam (Oxford Mus., type ♂), Amani (coll. du Buysson, type ♀).

I have much pleasure in naming this beautiful new species after my friend Vicomte R. du Buysson of the Paris Museum.

Periplaneta stygia sp. n.

♂. Piceous. Antennae infuscated, piceous at base. Pronotum of typical form, smooth, without impressions. Tegmina and wings barely exceeding apex of abdomen. Wings dark castaneous, median vein bifurcate, the rami dichotomously branched, a minute apical triangle. Mesonotum and metanotum without membranous processes. Scent-gland opening on 1st abdominal tergite. Abdomen above castaneous at base; supra-anal lamina quadrate, posteriorly faintly concave with a V-shaped notch in the middle of the posterior margin. Sub-genital lamina slightly exceeding the supra-anal lamina, quadrately produced, posteriorly emarginate, styles long and slender.

Total length 24 mm; length of body 23 mm; length of tegmina 18 mm; pronotum 6×8 mm.

Kamerun (coll. Bolivar, type).

Deropeltis brevipennis sp. n.

♂. Uniformly piceous. Pronotum finely punctate with a few smooth spaces, two oblique impressions. Tegmina and wings not extending beyond the third tergite. Scutellum exposed. Supra-anal lamina quadrate, angles rounded, surpassed by the sub-genital lamina.

♀. Uniformly piceous, finely punctate, opaque. Posterior margin of pronotum straight, posterior angles of thoracic tergites not produced. Posterior angles of abdominal tergites not spiniform.

Length (♂) 20—23 mm, (♀) 21 mm; length of tegmina 8,5—10 mm; pronotum (♂) 5×7 mm, (♀) $5 \times 7,8$ mm.

Erythraea, Asmara.

The male can readily be distinguished by the short tegmina and wings, the female is very like that of *D. autraniana* Sauss. but is less nitid.

Sub-fam. *Panchlorinae*.Genus *Anchoblatta* nov.

Antennae rather stout, not extending beyond the middle of the abdomen. Eyes wide apart. Pronotum barely covering vertex of head, in ♂ truncate anteriorly, anterior and lateral margins slightly reflected, disc rugose and tuberculate, posteriorly arcuate; in ♀ not truncate anteriorly, margins not reflected, disc almost smooth. Tegmina and wings extending beyond the apex of the abdomen. Supra-anal lamina, (♂) quadrate, apex emarginate, extending beyond the sub-genital lamina which is trigonal, symmetrical with two slender styles; (♀) sub-bilobate, barely exceeding the semi-orbicular sub-genital lamina. Cerci very short, apical joint enlarged. Hind-femora with 1 spine on the posterior margin and 1 genicular spine. Tibiae with outer spines tri-seriate. Posterior metatarsi shorter than the remaining joints: all the joints unarmed, their pulvilli large; tarsal arolia present. Femora without apical spines.

Anchoblatta peruana sp. n.

♂. Sordid testaceous, nitid. Antennae fuscous, rufescent at base and apex. Head, legs and abdomen beneath rufo-testaceous. Pronotum anteriorly with two widely separated tubercles, behind these a horseshoe-shaped ridge enclosing a median area which is rugose and sub-tuberculate, the disc is suffused with castaneous, the borders are hyaline with fine testaceous maculation.

♀. Head and legs darker; disc of pronotum with slight impressions, uniformly castaneous, margins hyaline and spotted with testaceous. Abdomen castaneous.

Total length (♂) 27 mm, (♀) 29 mm; length of body (♂) 22,5 mm, (♀) 25 mm; length of tegmina (♂) 23 mm, (♀) 24 mm: pronotum 7—7,2 × 9—9,1 mm.

Peru, Marcapata.

The species presents some similarity to *Proscratea*, but on account of the form of the supra-anal lamina I have no hesitation in placing it amongst the *Panchlorinae*. *Panchlora signifera* Scudder is very near this species but differs in size and in the armature of the mid- and hind-femora.

Genus *Pronauphoeta* nov.

Allied to *Nauphoeta* but the pronotum posteriorly obtusely produced and with the sides deflexed as in *Panchlora*. Tegmina and wings extending considerably beyond the apex of the abdomen. Sub-genital lamina (♂) slightly asymmetrical, 2nd and 3rd pair of femora with genicular spines; formula of apical spines as in

Nauphoeta: posterior femora armed on the posterior margin beneath with 1—3 spines. Posterior metatarsi shorter than the succeeding joints.

Pronauphoeta nigra sp. n.

♂. Very dark castaneous. Head piceous with ocelli and mouth-parts testaceous. Antennae fuscous, equal in length to the body. Frons depressed, concave; eyes not approximated on vertex. Pronotum faintly punctate, anterior margins on either side of the head testaceo-hyaline. Tegmina seriate-punctate at base, reticulate at apex. Wings with the veins and marginal area castaneous, ulnar vein with 13 incomplete and 3 complete rami. Supra-anal lamina sub-quadrate, apex scarcely incised, not exceeding the subgenital lamina which is sub-transverse. Cerci short, apical joint enlarged. Femora and coxae testaceous, tibiae and tarsi testaceous; formula of apical spines $\frac{0}{1}$, $\frac{1}{1}$, $\frac{1}{1}$; Hind-femora with 1—2 spines on the posterior margin beneath.

Total length 21 mm; length of body 15 mm; length of tegmina 17 mm; pronotum $5 \times 6,2$ mm.

Kamerun (Conradt) (Deutsch. Ent. Nat.-Mus., type).

The other species of the genus are *Panchlora smaragdina* Br. (syn. *P. vitellina* Gerst.) and *P. adusta* Gerst. The genus is intermediate between *Panchlora* and *Nauphoeta*, for the species that I include in it have the pronotum and the subgenital lamina of the male as in *Panchlora* but the armature of the femora as in *Nauphoeta* and consequently I consider it advisable to separate the species exhibiting these characters from *Panchlora*. Three true species of *Panchlora* are found in Africa, viz. *P. stolata* Borg, *P. camerunensis* Borg and *P. vosseleri* Shelf.

Sub-fam. *Oxyhaloinae*.

Areolaria sumatrana sp. n.

♀. Head rufous (antennae missing). Pronotum transversely sub-quadrate, punctate, rufous, the lateral and posterior margins testaceo-hyaline. Tegmina piceous, seriate-punctate, marginal area and discoidal sectors testaceous. Wings castaneous, mediastinal vein 3-ramose, 12 costals, these with the rami of the mediastinal vein incrassated, medio-discal area nearly twice as broad as medio-ulnar, ulnar vein bifurcate, 1st axillary vein 4-ramose, triangular apical area large. Abdomen above and beneath and legs orange-rufous.

Total length 8,2 mm; length of tegmina 6,6 mm; pronotum $2 \times 2,8$ mm.

Sumatra (Deutsch. Ent. Nat.-Mus., type).

Allied to *A. signata* mihi but differently coloured.

Genus *Anareolaria* nov.

Allied to *Areolaria*, Br. and *Paraplecta* mihi but differs from the former by the non-incrassated antennae, and the trapezoidal pronotum almost covering the vertex of the head and with deflexed margins. Differs from the latter genus by the corneous tegmina, extending beyond the apex of the abdomen, seriate-punctate at base.

Anareolaria bolivari sp. n.

♂. Rufo-castaneous. Head minutely punctate; eyes wide apart; antennae fuscous with 2 joints near the apex testaceous. Pronotum punctate, lateral margins slightly reflexed, sides deflexed; scutellum exposed. Tegmina with venation somewhat obscured, 15 ramose costals, radial vein bifurcate, anterior ulnar bifurcate, 7 discoidal sectors, discoidal field reticulated, anal and mediastinal fields seriate-punctate; the portion of the right tegmen overlapped by the left piceous. Wings castaneous, 12 irregular costals, median vein bifurcate from near base, ulnar vein 6-ramose, all but the last ramus incomplete, vena dividens strongly curved, 1st axillary 6-ramose, triangular apical area prominent; anterior part of the wing semi-corneous. Abdomen above flavo-testaceous, supra-anal lamina sub-quadrate with rounded angles. Abdomen beneath rufo-castaneous; sub-genital lamina slightly asymmetrical not exceeding the supra-anal lamina, with 2 slender styles. Cerci very short, barely exceeding the apex of the abdomen. Legs with the coxae, tibiae and tarsi castaneous, femora flavo-testaceous, tibial spines rufous. Tarsal arolia present.

Total length 11,1 mm; length of body 10 mm; length of tegmina 9,5 mm; pronotum $2,9 \times 3$ mm.

Kamerun (coll. Bolivar, type).

The wing-venation is very like that of *Notolampra gibba* Thunb.

Genus *Evea* nov.

Allied to *Paraplecta* mihi, but wings absent and tegmina reduced to squamiform lobes. Eyes very wide apart and considerably reduced in size. Supra-anal lamina rotundate, apex faintly emarginate. Sub-genital lamina ample, produced, not exceeding the supra-anal lamina. Cerci short, acuminate. Femora entirely unarmed beneath; tibiae rather short, spines on outer aspect in 3 rows. Tarsi elongate, posterior metatarsus exceeding the remaining joints in length, pulvilli minute, arolia absent.

Evea Kalkmanni sp. n.

♀. Elliptical, castaneous, nitid with a few scattered minute punctures. Eyes further apart than antennal sockets, almost concealed under the pronotum. Antennae testaceous, only half the length of the body. Mouth-parts testaceous. Pronotum not covering the vertex of the head, trapezoidal, sides deflexed, posteriorly truncate. Tegminal lobes extending shortly beyond posterior margin of the mesonotum. Posterior angles of abdominal tergites slightly produced. Cerci rufescent, broad at base, pointed at apex. Abdomen beneath rufescent. Legs testaceous.

Length 12 mm; pronotum 3×3.5 mm.

Kamerun (Kalkmann), (Wiesbaden Museum, type).

Sub-fam. *Perisphaeriinae*.*Derocalymma gigantea* sp. n.

♀. Large, dark castaneous, nitid. Head elongate, punctate, frons concave. Eyes touching on vertex of head. Antennae unicolorous piceous. Upper surface granulate. Pronotum with disc cucullate, anteriorly a short median carina, sides broadly flattened, no sulci between disc and lateral margins, posteriorly obtusely produced. Angles of meso- and meta-notum and of all the abdominal tergites backwardly produced. Abdomen beneath and legs piceous. All the tergites are much broader than the sternites, so that the abdominal sternites are overlapped very considerably by the abdominal tergites. Supra-anal lamina quadrate, surpassing the sub-genital lamina. Cerci minute.

Length 30 mm; pronotum 9×19 mm; mesonotum 3×20 mm. German E. Africa.

This is a remarkable species of a genus that is characterised by numbers of species resembling each other so closely that it is difficult to distinguish them. Apart from its large size *D. gigantea* can readily be recognised by the absence of pubescence from all parts of the body except the underside of the tergites where they overlap the sternites.

Genus *Karnyia* nov.

Both sexes entirely apterous. Head completely covered by the pronotum which is cucullate, without impressions, posteriorly truncate, sides not reflexed, beneath without carinae; all the thoracic tergites finely fimbriate on their outer margins. Sub-genital lamina (♂) asymmetrical, without styles. Tibial spines in 3 rows. Tarsi moderately long with large pulvilli, posterior metatarsus scarcely shorter than succeeding joints, arolia small.

Type of the genus *Hyposphaeria burri* Karny. (Denkschr. med.-nat. Ges. Jena XIII p. 389, pl. 22 f. 40 1908.)

Dr. Karny has kindly lent me the type of this species and I find that it is not a ♀ as stated by him but a ♂. A ♀ is in the collection of the South African Museum, labelled *Blepharodera discoidalis* Burm., an identification that is palpably incorrect. This new genus can be distinguished from all others in the subfamily *Perisphaeriinae* by the fimbriate thorax and absence of tegmina and wings in both sexes.

BLATTIDAE

OF

SPANISH GUINEA

BY

R. SHELFORD

This small collection was entrusted to me for examination one or two years ago by Sr. D. Ignacio Bolívar but I have only recently had an opportunity to examine it critically. As might have been expected the majority of the species are already known from Kamerun, from which district large collections of cockroaches have been sent to European museums and have been studied by Gerstaecker, Borg and myself.

Gen. **Theganopteryx** *Brunner.*

1. **Theganopteryx nitida** *Borg.*

1 ♂. Previously recorded from Kamerun.

2. **Theganopteryx lucida** *Br.*

1 ♀. A variety with the pronotum strongly marked with two fuscous vittae.

I have examined the type of this species, now in the Stettin Museum; Brunner suggested Australia as the habitat of the species but I have found identical specimens in collections from West Africa and believe that the type came from Old Calabar originally.

3. *Theganopteryx fantastica* sp. n.

♂. Pale flavo-testaceous. Head and antennae unicolorous; eyes piceous, close together on the vertex of the head. Pronotum trapezoidal. Tegmina with 19 costals, radial and anterior ulnar veins simple, posterior ulnar 5-ramose. Wings hyaline, costal margin faintly suffused with flavous, mediastinal vein simple, 18 costals, the more proximal slightly incrassate, medio-discal area nearly 4 times broader in the middle than the medio-ulnar area, crossed by about 13 transverse venules, a prominent apical triangle, 1st axillary 4-ramose.

1st abdominal tergite produced as a flat narrow process extending nearly to the apex of the abdomen slightly spatulate at its apex, 8th tergite with the posterior angles strongly produced; supra-anal lamina quadrately produced, sub-lobiform, covering the bases of the cerci which are situated close together. Sub-genital lamina produced, asymmetrical, apex concavely emarginate, two minute styles. Femora moderately armed, front pair with 3 stout spines on the anterior margin beneath, succeeded distally by piliform setae.

♀. Similar, eyes less close together on vertex of head. Wings uniformly suffused with pale flavid.

Supra-anal lamina produced, trigonal; sub-genital lamina semi-orbicular, ample.

Total length (♂) 9 mm., (♀) 11; length of body (♂) 8.1 mm., (♀) 9.6; length of tegmina (♂) 7 mm., (♀) 9.5; pronotum (♂) 2.9 × 3.2 mm., (♀) 3 × 4.5.

2 ♂♂. This very remarkable species also occurs in Kamerun (coll. Bolívar, Berlin Mus., types). The modification of the secondary sexual apparatus of the male is quite without parallel amongst the Blattidae and combined with the approximation of the eyes on the vertex of the head—an unusual feature in this genus—should render the species easy to determine.

4. *Theganopteryx patricia* Gerst.

2 ♂♂. Differing from Kamerun examples by the unicolorous antennae.

5. *Theganopteryx circumcincta* Reiche et Fairm.

1 ♀. An examination of all the types of the African species of this genus and of long series of specimens from different localities convinces me that this highly variable species, which has been described over and over again, ranges over the greater part of tropical Africa and cannot be split up satisfactorily even into local races. The unique Biafra specimen has the tegmina rufo-castaneous, short and lanceolate.

Gen. *Anaplecta* Burm.

6. *Anaplecta dahomensis* Shelf.

3 examples. Previously known from Dahomey.

7. *Anaplecta biafrae* sp. n.

Unicolorous rufo-testaceous. Tegmina with 12 costals, radial vein simple, 3 longitudinal discoidal sectors. Wings castaneous, radial vein bifurcate from base, 7 costals, joined at their bases by anastomoses, median vein straight not obsolescent at base, medio-discal area scarcely broader than medio-ulnar area, crossed by 3 transverse venules, ulnar vein simple, 1st axillary 3-ramose, apical area not angled at base, equally divided by vena dividens, upper half crossed obliquely by a dark castaneous band, lower half by an obliquely curved vein; length of apical area $\frac{2}{3}$ of total wing-length.

Total length 6 mm.; length of tegmina 4-1 mm.

One example with the abdomen missing.

Gen. *Ischnoptera* Burm.

8. *Ischnoptera cinnamomea* Gerst.

(Syn. *Ischnoptera basalis*, Gerst. ♂.)

1 ♂, 4 ♀♀. This and the next species are common insects in Kamerun.

9. *Ischnoptera punctifrons* Gerst.

1 ♀.

Mem. Soc. esp. Hist. nat., 1, 1909,

10. *Ischnoptera escalerae* sp. n.

♂. Castaneous above, pronotum and tegmina laterally margined with testaceous. Legs and abdomen beneath testaceous. Vertex of head rufo-castaneous, antennae infuscated. Tegmina and wings considerably exceeding apex of abdomen. Tegmina with 16 costals, radial vein simple, 16 longitudinal discoidal sectors, anterior ulnar 3-ramose. Wings with veins castaneous, marginal area rufescent, mediastinal vein 4-ramose, 8 non incrassated costals, radial vein simple, ulnar vein 7-ramose, 3 rami being incomplete, no triangular apical area. Posterior angles of 6th abdominal tergite strongly produced as blunt processes; scent-gland with triple opening on 7th tergite, concealed beneath the 6th tergite; supra-anal lamina produced, trigonal. Sub-genital lamina asymmetrical, a pair of stout pointed styles, bifurcate at apex. Cerci testaceous. Femora armed in the manner normal to the genus.

♀. Paler, a band between the eyes, a V-shaped mark on the frons, a complicated design on the pronotum, some maculae on the coxae, the disc of the sub-genital lamina, fusco-castaneous. Supra-anal lamina trigonal, shorter than in the ♂, apex subtruncate, not emarginate.

Total length (♂) 17.9 mm., (♀) 18.1; length of body (♂) 12.2 mm., (♀) 14.8; length of tegmina (♂) 14.8 mm., (♀) 15; pronotum 4 × 4.3 mm.

1 ♂, 1 ♀.

The species is allied to *I. cinnamomea* Gerst. but differs in the secondary sexual apparatus of the male; the female resembles the corresponding sex of *I. sordida* mihi, but is larger and the apex of the supra-anal lamina is not incised.

Gen. *Phyllodromia* Serv.11. *Phyllodromia germanica* L.

1 ♂. A cosmopolitan species.

12. *Phyllodromia centralis* Gerst.

1 ♂, 1 ♀. A Kamerun species.

13. *Phyllodromia* sp.?

1 ♀. A form with two castaneous vittae on the pronotum and the tegmina and wings not exceeding the apex of the abdomen. It is advisable to postpone the description of this species until the male is discovered.

Gen. *Liosilpha* Stål.14. *Liosilpha* *bicolor* Shelf.

1 ♂. Originally described from Kamerun.

Gen. *Epilampra* Burm.15. *Epilampra* *erubescens* Gerst.

2 ♂♂, 2 ♀♀. All the species of this genus found in this collection were originally described from Kamerun.

16. *Epilampra* *camerunensis* Borg.

1 ♀.

17. *Epilampra* *infinita* Borg.

1 ♀.

18. *Epilampra* *minuta* Borg.

1 ♂, 1 ♀.

Gen. *Periplaneta* Burm.19. *Periplaneta* *australasiæ* Fab.

1 ♀. Cosmopolitan.

Gen. *Leucophaea* Brunner.20. *Leucophaea* *surinamensis* L.

1 ♀. Cosmopolitan.

Gen. *Nauphoeta* Burm.21. *Nauphoeta* *frenata* Gerst.

1 ♀. Previously recorded from Kamerun.

22. *Nauphoeta* *elegans* Shelf.

1 ♀. Another Kamerun species.

Mem. Soc. esp. Hist. nat., 1, 1909.

23. *Nauphoeta epilamproides Shelf.*, var.

1 ♂ differing from the typical Kamerun form in its slightly larger size and in the presence of broad fuscous vittae on the pronotum.

Gen. *Holocompsa* *Burm.*

24. *Holocompsa nitidula Fabr.*

1 ♀. The species is now found in most of the tropical regions of the world.

Gen. *Ipisoma* *Bol.*

25. *Ipisoma coleoptratum Bol.*

1 ♂. The species was known only from a female from Assinie, the following is a description of the male:

Fuscous; antennae and legs testaceous. Antennae as long as the body; eyes widely separated. Pronotum as in the ♀. Tegmina and wings exceeding the apex of the abdomen. Tegmina overlapping considerably, the part of the right tegmen overlapped by the left, hyaline; margins shortly fimbriate; 10 costals, discoidal sectors oblique, discoidal field reticulated. Wings hyaline, veins and a suffusion in marginal field testaceous; posterior part of wing much reduced, radial vein bifurcate from base, the upper ramus bearing 3 costals, the lower ramus with 5, ulnar vein with 5 sinuate rami. Supra-anal lamina short, transverse. Tarsi without arolia. Length of body 6 mm.; length of tegmina 5 mm.

Gen. *Oxyhaloa* *Brunner.*

26. *Oxyhaloa minima* sp. n.

♂. Differs from *O. perspicua* mihi in its much smaller size, in the rufous colour of the head, body and legs; the first 24 joints of the antennae are piceous, the remainder rufous; ulnar vein of wing with 10 rami; abdomen above with the disc piceous; cerci without a testaceous spot at base beneath; tarsi piceous.

Total length 11.2 mm., length of body 9 mm., length of tegmina 8.8 mm., pronotum 2.8 mm. × 3.5 mm.

1 ♂. The smallest species of the genus,

Gen. *Isoniscus* Borg.27. *Isoniscus scaber* sp. n.

♀. Convex, with a dense sericeous grey pile above and numerous erect tufts of minute scales, so that the upper surface appears pustulose. Head with sericeous pile, eyes less wide apart than the antennal sockets, ocelli absent. Antennae rufescent in basal third, remainder fuscous except for 4 testaceous joints immediately before the apex. Pronotum with anterior margin faintly emarginate in the middle, the posterior angles of all the tergites produced, but much less so than in *I. sjöstedti* Borg. Supra-anal lamina trapezoidal, narrower at base than at apex, posterior margin rounded. The margins of the tergites overlap the sternites. Abdomen beneath nitid, disc rufescent. Legs rufescent, outer margins of tibiae darker, tibial spines in 3 rows stronger and longer than in *I. sjöstedti*, tarsal arolia absent.

Length 17 mm.; pronotum 5.9 mm. \times 9 mm.

1 ♀.

This species shows that the natural position of this genus is in the *Perisphacriinae* and not in the *Panchlorinae* as suggested by Borg; *Isoniscus sjöstedti* is an aberrant species in which the *Perisphacriine* characters are masked.

Madrid, 1.º de Junio de 1909.

XVI. *Two remarkable forms of Mantid oothecae.* By
R. SHELFORD, M.A., F.L.S., F.Z.S.

[Read October 20th, 1909.]

PLATE XVII.

IN a miscellaneous collection of insects formed by the late Mr. F. P. Pascoe and recently presented to the Hope Department, Oxford University Museum, by Miss Pascoe, was found a box containing five Mantid oothecae from Delagoa Bay. These specimens, together with an ootheca found at Chamicuros, Peruvian Andes, by the late Edward Bartlett and now in the Oxford Museum,* are so unlike the usual type of Mantid egg-case, that descriptions and figures of them will not be without interest.

The East African specimens, which vary considerably in size (30 mm.—15 mm. in length \times 14 mm.—12 mm. in diameter), are semi-transparent, bladder-like structures, elongate-oval to almost spherical in shape and straw-yellow in colour. Each is attached by a slender ring of parchment-like consistency to the twig of a plant. The substance forming the walls of an ootheca also resembles very thin parchment and is in direct continuity with the attaching ring; its surface is seen to be finely reticulated, an appearance that is due to the inclusion of air-bubbles in this dried and hardened secretion of the thecogenous glands. The oothecae are firmly attached and stand out from the twigs at varying angles. Along the middle line on the upper surface of the ootheca there runs a well-defined ridge. This ridge is made up of a double series of empty cells, 70 to 40 in number, open at the top but closed at the bottom, so that they do not communicate with the interior of the ootheca. The outer walls of these cells are higher than the inner walls, the ridge, consequently, when viewed from above, appears to be grooved; the inner cell-walls of one series interdigitate with the inner cell-walls of the other series in a perfectly regular and sym-

* The South American specimen bears the label "♂, ♀ and nest," but I have not been able to find the insects in the Hope collection of Mantidae.

metrical way. When an ootheca is cut open a septum will be seen dividing the oothecal cavity almost completely into a right and left half; it extends inwards from immediately below the ridge on the upper surface of the oothecal wall towards the opposite wall, which, however, it does not reach. The septum is a homogeneous vesicular membrane of no great thickness but quite opaque; its free border is irregular in outline. The eggs are placed in 15 to 20 rows on either side of the septum with their long axis at right angles to it and with the heads of the embryos directed outwards; they form two compact masses which do not cover the whole of the septum but only about a third of its surface, extending from the free border towards the line of attachment. In one of the larger oothecae there are 136 eggs situated on one side of the septum and apparently an almost equal number are to be found on the other side. There is no information accompanying the specimens, so that it is not possible to say if they were made by a single or by more than one individual.

The South American specimen is rather different in appearance from the Delagoa Bay examples, though it is built on essentially the same plan. It is almost a perfect sphere, 15 mm. in diameter, hollow, dark green in colour and semi-transparent; its walls are quite smooth with the exception of inconspicuous reticulations, and there is no ridge as in the African specimens. The ootheca is borne on a slender tubular stalk, and no doubt this was originally attached to a twig, but it has been cut by the collector so that the method of attachment cannot be determined now. In the centre of this hollow sphere is an imperfectly spherical mass of densely vesicular material like dried foam in appearance. About 80 eggs are embedded in this mass, they are set close together with the anterior pole directed outwards and their arrangement is, roughly speaking, radiate. This central egg-mass is attached to the outer wall of the ootheca by a thin septum which incompletely divides the ootheca into two halves; the line of attachment of this septum corresponds to that of the septum in the East African oothecae and undoubtedly the two structures are homologous. A few fragile strands of dried foam help to moor the central egg-mass to the surrounding wall of the ootheca.

The accompanying diagrammatic figures of transverse

sections through the two oothecae, together with the photographs, should make clear anything that is at all obscure in the foregoing description.

These two forms of *Mantid* oothecae differ radically from all those that have previously been described on account of their hollow nature, whereby the enclosed mass of eggs

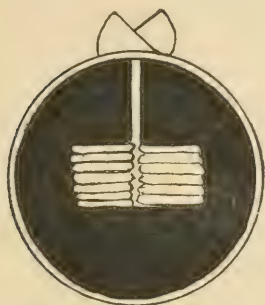


FIG. 1.—Diagrammatic transverse section of the ootheca from Delagoa Bay.



FIG. 2.—Diagrammatic transverse section of the ootheca from the Andes.

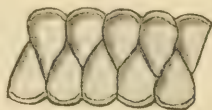


FIG. 3.—Portion of the grooved ridge of the Delagoa Bay ootheca viewed from above.

is surrounded by an empty air-space. Thanks to the admirable researches of Giardina* we are acquainted with the structure and method of formation of the ootheca of the European Mantis, *M. religiosa*. In this species—and it is probable that in nearly all the *Mantinae* the structure of the ootheca is essentially similar—the eggs are enclosed in a double series of thin-walled cells; the cells, except a few at the anterior and posterior ends of the ootheca, are practically divided into an internal and an external half; the former contain the eggs, the latter are empty and together form a thick spongy layer protecting the inner core of eggs. Each egg-cell communicates with the exterior by a narrow passage, opening on the upper surface

* Natural. Siciliano (N.S.), Anno II, and Giorn. Soc. Sci. Nat. Econ. Palermo, XXII (1899).

of the ootheca, which here presents a double series of imbricating scales; these scales are in reality the free ends of the lamellae which form the walls of the egg-cells and between them lie the passages to the interior of the egg-cells. The young larvae, when ready to emerge, have merely to push their way along the "canali di uscita," as Giardina terms them, in order to gain access to the outer world. This is a very bald description of an extremely complicated structure, but it suffices for my present purpose, and readers anxious for further details must consult Giardina's two memoirs. The nests of species of *Ameles* are described by the same authority; they chiefly differ from that of *Mantis religiosa* by the presence of a grooved ridge apparently very like that in the East African oothecae here described; at the bottom of the ridge occurs the double row of the openings of the "canali di uscita." The ridge, in fact, is strictly homologous with the double row of imbricating scales in the nest of *Mantis* and is formed by the free ends of the lamellae composing the walls of the egg-cells. I will return to this point later.

The ootheca of *Gongylus gongylodes* (sub-fam. *Empusinae*) has been described in some detail by Captain C. E. Williams in the Transactions of this Society for 1904, pp. 129-131, and I need not allude further to this excellent piece of work beyond remarking that the egg-cells are not protected by a surrounding spongy layer of empty cells but by a layer of hardened foam only $\frac{1}{8}$ in. thick; the young larva "softens the end of the cell in which it lies, and this falls outwards as a small disc hanging by a silk thread," and the larva is now free to walk out of its prison. The ootheca of *Hymenopus bicornis* (sub-fam. *Harpaginae*) is very like that of *Gongylus* and the emergence of the larvae is effected in the same manner.

Turning now to the Blattidae, which are more nearly related to the Mantidae than is any other family of the Orthoptera,* we find that the ootheca of a species such as *Blatta orientalis* is a chitinous capsule in which the eggs are tightly packed; when the larvae are ready to emerge either by their movements or perhaps by the action of a cephalic ampulla (cf. Mlle. Pavlova, Zool. Anz., 1895, p. 7)

* Handlirsch (Die fossilen Insekten, p. 1290) regards the Blattidae and the Mantidae as orders of the sub-class *Blattaeformia*, and the Acridiidae + Locustidae + Gryllidae, the Phasmidae and the Dermaptera as orders of the sub-class *Orthopteroidea*.

the sides of the capsule are forced apart and the larvae are liberated.

But the larvae of the *Mantidae* that formed the remarkable oothecae described in this paper, when they throw off their egg membranes are in very different case, for they find themselves in a relatively vast and empty space, the walls of which are both tough and smooth. They can find no *point d'appui* whence they can exert pressure on the oothecal wall, and it is difficult to see how with their tender mandibles they can gnaw their way through this resistant tissue. At one time I was inclined to believe that the ridge on the East African oothecae was a line of dehiscence and marked, so to speak, the line of least resistance in the structure. But this is not so, the ridge is the toughest part of all, and even if it was a line of dehiscence, where is this line in the South American specimen? For the release of the larvae, then, either the bladder-like oothecae must crack open at the propitious moment, or, as appears more probable, the larvae are provided with some special organ that enables them to pierce or rasp a way through the walls of their prisons.

The grooved ridge on the East African ootheca deserves another word of notice. Superficially it resembles the grooved ridge on the ootheca of *Ameles* and might be regarded as formed in a similar way. But this cannot be so. The ridge of the ootheca of *Ameles* is the product of the free ends of the lamellae forming the walls of the egg-cells; as each cell is made and each egg laid a portion of the ridge is formed and its construction proceeds *pari passu* with the growth in size of the ootheca. It is plain, therefore, that each element or division of the ridge is in direct relation with an egg and egg-cell. The ridge in the African oothecae is, as stated, made up of a double series of compartments, but these compartments bear no relation to the internal structure of the ootheca. The septum is homogeneous and shows no trace of the segmental arrangement characteristic of the internal structure of the ootheca of other *Mantidae*. Moreover, the eggs not only lie at right angles to the direction of the ridge, instead of in the same plane as in *Ameles*, but are also much more numerous than the compartments of the ridge, and the number of rows in which they are arranged is less than the number of compartments. It seems, then, almost certain that this grooved ridge is functionless as

regards the emergence of the larvae, so that if it is the morphological equivalent of the grooved ridge in *Ameles* ootheca and of the imbricating scales of *Mantis* oothecae—and I am by no means convinced that this is the case—it is certainly not the physiological equivalent of those structures. The sequence of events in the construction of the African oothecae can, in the absence of direct observations, only be guessed at. The first part to be formed is evidently the attaching ring, then on this is built in a semi-circular sweep the grooved ridge, to which is fixed the septum with the eggs; the final stage in the process is probably the formation of the thin enveloping wall. Such may or may not be the sequence of events—an hour's observation of the living insect at work can upset the most closely-reasoned theory formed in the museum or laboratory. It is noteworthy that neither in the African nor South American oothecae are the eggs enclosed in separate cells.

Bilateral symmetry, which is so marked a characteristic of all Mantid oothecae, is clearly distinguishable in the African egg-cases here described, but is scarcely to be distinguished in the South American specimen owing to its spherical shape and to the radiate arrangement of the eggs; the position of the septum is the only feature that remains to show that this ootheca is derived from a bilaterally symmetrical form.

A much reduced figure of an ootheca from the Egyptian Sudan, closely resembling those described above from Delagoa Bay, is figured on Plate II of SitzB. Kais. Akad. Wiss. math. naturw. Klasse cxvi, Abt. 1 (1907); it was taken at Gondokoro by Dr. Fr. Werner. There is no mention of it in the text.

EXPLANATION OF PLATE XVII.

[See *Explanation facing the PLATE.*]

EXPLANATION OF PLATE XVII.

FIG. 1. Oothecae of Mantid from Delagoa Bay.

A. An ootheca cut open, showing the eggs and median septum.

B. Portion of oothecal wall removed from A.

C. Intact ootheca.

Ootheca of Mantid from the Andes split open to show the central egg-mass.



Photo, A. Robinson.

MANTID OOTHECAE.

XIX. *Further Studies of the Tetriginæ (Orthoptera) in the Oxford University Museum.* By J. L. HANCOCK, M.D., F.E.S. (Chicago.)

(Second Paper.)

[Read June 3rd, 1908.]

PLATE XXII.

THE author takes this opportunity to acknowledge his gratefulness to Professor E. B. Poulton, F.R.S., Hope Professor of Zoology in Oxford University, for the privilege of studying the remainder of the collection of *Tetriginæ (Orthoptera)*. The latter collection consisted of one hundred and thirty-eight examples. Of this series, which are representative of widely varied localities, a number are new, some proving to be unique types. Still others are of historical value, having been collected by Wallace in the Malay Archipelago, and by Bates on the Amazon in South America. These insects formed part of the notable collection of W. W. Saunders, which was purchased and donated by Mrs. F. W. Hope to the Hope department of Zoology, University Museum. The author's first paper on the collection of *Tetriginæ* in the University Museum appeared in the Transactions of the Entomological Society of London; * the present paper is a continuation of that contribution.

Section *LOPHOTETTIGIÆ*, nov.

In this new section the body has a general resemblance to *Tripetaloceræ*. The vertex is often greatly widened, transverse, the eyes substylate; the structure of the antennæ is especially characteristic, being filiform and strongly incrassate, or toward the apices often more or less gradually but distinctly flattened or dilated; the pronotum is more often truncate anteriorly or little excavate at the middle of the front margin, and backwardly prolonged into a posterior process; the median carina between the shoulders frequently compresso-cristate or the dorsum strongly compressed and foliaceous; the lateral lobes of pronotum more or less laminate, reflexed outwards, and

* pp. 213-244, Plate XXI, 1907.

dentate produced or obliquely truncate behind; elytra and wings of ordinary form; the first and third articles of the posterior tarsi equal in length.

The species so far known occur in South America.

Genus LOPHOTETTIX, nov.

Resembling *Gladiotettix* (*Nephele*), but differing in having stouter, more dilated, and flattened antennæ, in the fewer antennal joints, which consist of but ten distinct articles, the somewhat stouter and more rugose body, the more distinctly compresso-foliaceous dorsum of pronotum, and in the more laminate lateral lobes.

The type is *L. brevicristatus* described below.

1. *L. brevicristatus*, sp. nov. (Plate XXII, fig. 1, *a* & *b*.)

A moderately crassate form (female) bearing a low dorsal crest between the shoulders, the body strongly rugose, ferruginous. Antennæ very thick, consisting of ten conspicuous articles (a minute barely distinguishable acute apical article might be considered as the eleventh), the first article short and thickened, the second small and globose, from the third to the seventh inclusive gradually dilated toward the individual apices, the eighth and ninth dilated at the middle and subexcavated longitudinally, the last articles pale yellow, antennæ inserted far anterior to or below the eyes; the posterior ocelli situated opposite the lower margin of the eyes. Vertex very wide, transverse, not at all produced, little more than twice the width of one of the prominent globose, substylate eyes, the front transversely imperfectly carinate, bearing on each side a small tuberculiform carinula next to the eyes opposite their anterior fourth, and foveate on each side of the obscure median carina between the middle of the eyes; frontal costa abruptly widened between the posterior ocelli, parallel, the facial carina above depressed, costa between the antennæ distinctly protuberant. Pronotum anteriorly truncate, but shallowly excavate at the middle; dorsum between the shoulders compresso-cristate (about three millimeters in height above the shoulders), the crest highest between the humeral angles, somewhat translucent punctate when held against the light, the front margin roundly excavate, dentate-crenulate, above anteriorly little angulate produced as far as the anterior sulcus; dorsal margin of crest viewed from above not sulcate but strongly sinuate; viewed in profile arcuate and crenulate-sinuate, posteriorly opposite the articulation of hind femora, suberose

and dentate; dorsum rugose and on posterior process rugose-reticulose; humeral angles not prominent and widely subrounded, process lengthily subulate, apex little upturned and acute, extended beyond the apices of posterior femora; lateral lobes posteriorly bisinuate, posterior angles distinctly laminate and terminating in a laterally produced obtuse denticle, behind minutely serrulate, truncate. Elytra of moderate size, externally punctate, substraight or concave above, strongly arcuate below, apices narrowly rounded; wings fully explicate reaching nearly to the apex of pronotal process. Anterior and middle femora elongate, margins sinuate sublobate, superior carinæ of middle tibiæ compresso-dentate at the middle; margins of posterior femora minutely serrulate and sinuate-dentate, the antegenicular and genicular lobes stout and prominent; hind tibiæ fuscous, the margins lightly serrulate and armed with rather obtuse spines, the first articles of the posterior tarsi having the third obtuse pulvilli little longer than the second.

Entire length of body, female, 14 mm.; pronotum 13 mm.; antennæ 4.5 mm.; post. femora 6 mm.

One example from Brazil, South America, in the University Museum, Oxford.

2. *L. alticristatus*, sp. nov.

Differing from the preceding species in the darker almost black body, slightly tomentose below, in the dorsum bearing a much higher foliaceous crest, and in the obliquely truncate laminate subacute posterior angles of lateral lobes of pronotum, scarcely at all dentate produced laterally.

Body rugose; vertex very wide, transverse; eyes substylate; the transverse frontal carinulæ obsolete. Antennæ black and pale annulate at the joints, articles strongly dilated towards the individual apices and margins minutely serrulate and pilose; maxillary palpi having the two last articles flattened, dilated, the penultimate article oval, pilose. Pronotum anteriorly truncate, posteriorly subulate, and little longitudinally concave; dorsal crest strongly elevated between the shoulders equal to three and a half millimeters above the humeral angles, margin not at all sulcate, viewed in profile the front margin vertical erose and flush with the anterior border of the pronotum, the convex dorsal margin sloping backward and reaching as far as the middle of the wings, forward minutely denticulate and sinuate, behind dentate, viewed from above strongly sinuate, dorsum on either side and on the process lightly reticulate. Wings fully explicate, reaching scarcely beyond the pronotal apex; elytra having venate marking, punctate, and

apices somewhat widely rounded. Anterior and middle femoral margins sinuate-sublobate; middle femoral margins above acutely produced at the apices, the middle tibiæ pale annulate at the middle and margins little compresso-tuberculate; apical half of tarsi black.

Entire length of body, female, to end of wings 15 mm.; pronotum 13.5 mm.; (posterior femora mutilated.)

One example from Brazil, South America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

3. *L. unicristatus*, Hancock, Gen. Insectorum, 48 Fasc. Orthoptera, p. 40, 1906.

This is the species mentioned as above, in "Genera Insectorum," as *Nephele unicrista*. It was described by the author from a male example from British Guiana, which is in Bruner's collection. As my former description still remains unpublished, the following note may be of interest:

Allied to *alticristatus*, resembling it in colour of body, but differing in the somewhat smaller dorsal crest of pronotum, having its front border roundly excavate, minutely serrulate, and here bearing a median denticle as in *brevicristatus*, the anterior border above angulate but not denticulate produced, the dorsal margin of crest more evenly arcuate longitudinally from the front backwards, and being here slightly rugose subsinuate but not sinuate-erose as in *alticristatus*. Wings fully explicate, reaching backward nearly to the abruptly upturned pronotal apex. The first articles of the posterior tarsi bearing very small pulvilli, the third being very little longer than the rest.

Length of the entire body of the female 13 mm.; pronotum 12 mm.; posterior femora 6 mm.

One example collected by Bates in Colombia, South America; from the W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus GLADIOTETRIX, Hancock.

Genera Insectorum, 48 Fasc. Orthopt. p. 40, 1906.

= *Nephele*, Bolivar.

1. *G. turgidus* (Bolivar).

= *Nephele turgida*, Bolivar, Ann. Soc. Ent. Belg., xxxi, p. 252, 1887.

One male example from Brazil, South America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Section *CLADONOTÆ*, Bolivar.

Genus *PIEZOTETRIX*, Bol.

1. *P. truncatus*, sp. nov.

Resembling *cultratus* in having the margin of the dorsal crest entire, but differing in the arcuate profile and smaller stature.

Body granulate, coloured ochreous, slightly obscure fusco-marmorate on legs and median carina. Vertex wide, tumid, and elevated above the eyes, not at all transversely carinulate, but bearing a small carinula next to the eyes; frontal costa incrassate but in profile scarcely at all produced between the antennæ, the face advanced before the eyes nearly equal to one-half the width of one of the strongly conoidal eyes; superior ocelli placed much in advance of and opposite the lower fourth of the eyes; antennæ inserted barely below the anterior inferior margin of the eyes, shorter than the vertical diameter of the head; maxillary palpi little dilated. Pronotum strongly tectiform cristate, the dorsal margin of crest entire, arcuate, but not highly arched, viewed in front deltoidal; the lateral surfaces forward at the sulci rugulose, subvenose; lateral carinæ distinctly expressed; anterior margin in profile arcuate produced over and little beyond the head, angulate, subobtuse at the apex, posteriorly more sloping and abbreviated, the apex angularly truncate-incised, the process only extended to about the distal third of the hind femora. Elytra and wings wanting. Superior margins of anterior and middle femora entire, the inferior margins undulate or the anterior barely subunilobate, the mesothoracic subtrilobate; the posterior femora moderately inflated, antegenicular lobe somewhat conspicuous, the outer pagina above lightly nodulose, and externally bearing oblique rugulæ; hind tibiæ rather crassate, the margins armed with valid spines about four on the inside, and five on the outside; first articles of the posterior tarsi elongate, more than twice the length of the third, the three pulvilli subobtuse, gradually increasing in size from first to last.

Length of the entire body, female, 14·5 mm.; pronotum 11·5 mm.; posterior femora 8 mm.

One example from Morty Island, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus HOLOARCUS, nov.

Resembling *Piezotettix*, but differing in having all the margins of the pronotal crest entire and arcuate, the summit sulcate, in the almost obsolete lateral carinae, in the acute angled apex of posterior process, and the strongly dilated hind femora bearing denticulate margins.

Including the type *altinotus* herewith described, *Piezotettix arcuatus*, Haan, and *Piezotettix sulcatus*, Stål.

1. *H. altinotus*, sp. nov. (Plate XXII, fig. 2.)

Allied to *arcuatus*, Haan. Body ochreous-ferruginous; vertex wide, about twice the width of one of the eyes, elevated considerably higher than the eyes, tumid, with minute vestigial carinulae on each side next to the apices of the conoidal eyes; frontal scutellum triangular and open below, very slightly arcuate between the antennae; the antennae short filiform, as long as the face from vertex to clypeate margin below, inserted barely below the eyes; posterior ocelli placed distinctly in advance and little below the middle of the eyes; maxillary palpi having the last articles dilated, hirsute. Pronotum strongly compresso-foliaceous, the whole crest punctate-translucent when held against the light; anteriorly advanced over and beyond the head, the dorsal margin of crest presenting a highly arcuate outline in profile but little depressed forward above the lateral lobes, the summit sulcate, posteriorly the crest more sloping than in front, the apex acute angulate and extending backwards nearly to the apices of the posterior femora; sides of pronotum little rugose bearing light radiating reticulations; the lateral carinae very little expressed. Superior margins of anterior femora entire, the inferior lightly bidentate; middle femora elongate, margins subentire; posterior femora strongly dilated, the superior margin strongly arcuate, from the middle backward tridentate, the antegenicular and genicular lobes acute, the external pagina above longitudinally nodulose, bearing oblique rugae forward between the carinae but scabrous and interrupted distally; hind tibiae rather stout, the margins armed with ten or eleven valid spines, the inner margin having about six or seven spines; first articles of the posterior tarsi elongate, the third pulvilli distinctly longer than the second. Valves of the female ovipositor having the superior glades constricted at the middle, slender and denticulate.

Entire length of body, female (same as pronotum), 13.5 mm.; posterior femora 9 mm.; width 3.5 mm.

One example from Aru Islands, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus OXYPHYLLUM, nov.

Allied to *Xerophyllum*. Vertex wider than one of the eyes, little elevated, transversely carinate, middle carinate and strongly advanced beyond the eyes; frontal scutellum elongate gradually widened below, divided much above the posterior ocelli, just below the transverse carina of vertex between the upper part of the eyes; scutellum in profile little convexly elevated between the antennæ and sinuate between the upper part of the eyes; antennæ filiform, articles strongly elongate, inserted just between the lower margin of the eyes, the distance between them wider than that to the eyes. Pronotum strongly compresso-foliaceous, arcuate, entire, the crest thin and punctate-translucent, the summit regularly arcuate, not sulcate when viewed from above but sinuate, anteriorly extended over and beyond the head, posteriorly formed into a lengthily extended subulate acute process, passing much beyond the femoral apices; lateral lobes of pronotum posteriorly bisinuate, the posterior angles turned down somewhat obliquely and narrowly excised. Elytra oval; wings fully explicate. Anterior and middle femora little compressed, margins below somewhat lobate; posterior femora not at all dilated, elongate, the superior margins minutely denticulate, inferior margins sublobate-dentate, the antegenicular and genicular lobes small; first articles of the posterior tarsi little longer than the third.

The type is *O. pennatum*, described below.

1. *O. pennatum*, sp. nov. (Plate XXII, fig. 3.)

Body rather shining granulate; face little oblique; colour greyish-rufescent, bearing an obscure triangular marking on each side of the dorsum just above the apices of the elytra. Pronotum having the crest strongly elevated, the forward part anterior to the articulation of the hind femora regularly arcuate, behind that point gently slowing backward and slightly concave toward the pronotal apex, the process thin, acute and extended backward nearly to the apices of the outstretched hind tibiæ. Elytra oblong, finely reticulate, wings extended beyond the pronotal apex. Anterior and middle femora little compressed, the margins minutely serrulate, the inferior margins bearing two obtuse lobes; superior margins of middle femora little compressed, subundulate; hind tibiæ pale ochreous, and armed with weak spines; the first articles of the posterior tarsi

little longer than the third, all the pulvilli somewhat spiculate, the third nearly as long as the first and second combined and flat below.

Length of pronotum, female, 15 mm.; height of dorsum from humeral angles to the summit of crest 4.5 mm.; posterior femora 6 mm.; wings passing the pronotal apex 1.5 mm.

One example from Darjeeling, India, in the University Museum, Oxford.

THE GENUS *Cladonotus*, SAUSSURE, AND ITS ALLIES.

A study of the genus CLADONOTUS, Saussure, based on material in hand as well as the described species, would indicate that members of three genera are included within the genus as interpreted by Bolivar, that is taking the species in his "Essai"* and those described since the latter was published. These groups are presented in the following diagnostic table:

- | | |
|---|---|
| 1. Pronotum bearing a ramose process or crest, the front margin produced over the head, frontal facial scutellum widely concave between the antennæ | [NOTUS, Saussure.
I, Type genus CLADO- |
| A. Pronotal ramose process nearly vertical, bimarginate-serrulate behind | <i>C. latiramus</i> , Hancock. |
| A.A. Pronotal ramose process distinctly curved forward, extending forward beyond the head . . . | [sure.
<i>C. humbertianus</i> , Saus- |
| A.A.A. Pronotal crest bifid, undulate, denticulate at the summit . | <i>C. echinatus</i> , Stål. |
| 1.1. Pronotum destitute of ramose process, but often gibbose, or cristulate† | |
| 2. Lateral lobes of pronotum having the posterior angles somewhat smoothly laminate, obliquely truncate, the apices rounded, not at all armed | |

* Ann. Soc. Ent. Belg., xxxi, pp. 208-209, 1887.

† See description of *Gignotettix* further on, which is allied to *Cladonotus*.

3. Pronotum elevated between the shoulders, gibbose on each side of summit, flattened, declivous backwards; body asperous, viewed in front subquadrate; front margin truncate, tricarinate, not or very little produced at the middle. [TELLA, nov.
II, genus CLADON-
- A. Posterior femora having the superior margin armed with three acute trigonal spines . *C. gibbosa*, Haan.
- A.A. Posterior femora having the superior margin undulate, the femoral and genicular spines large, triangular *C. beccarii*, Bolivar.
- 2.2. Lateral lobes having the posterior angles strongly laminate-expanded, obliquely truncate, or erose-spiniform
- 3.3. Pronotum depressed, median carina cristulate-sinuate, dorsum posteriorly strongly fosculate reticulate, between the shoulders profoundly impressed, apex of process often angulate excised or abruptly acute; rami of frontal facial scutellum only slightly separated, often angulate, protuberant above antennal insertion . . . [nov.
III, genus TETTILOBUS,
- A. Lateral lobes of pronotum having the posterior angles strongly laminate expanded, erose-spiniform; spines of vertex elevated much above the eyes *T. spinifrons*, sp. nov.
- A.A. Lateral lobes having the posterior angles obliquely truncate, minutely serrulate . . . *T. interruptus*, Bolivar

Genus CLADONOTELLA, nov.

(Described in the diagnostic table.)

1. *C. beccarii*, Bolivar, Ann. Mus. Civ. Nat. Genova, ser. 2a, xix (xxxix), p. 66, 1898 = *Cladonotus beccarii*.

One female example referable to this species, collected by Wallace in New Guinea; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus TETILOBUS, nov.

(See diagnostic table.)

Resembling *Cladonotus*, Saussure. Body depressed; vertex on each side next to the eyes acuminate produced, spiniform, the vertical spines often elevated above the eyes; facial scutellum having the rami little separated, subparallel and not concave. Pronotum anteriorly truncate, tricarinate, little compressed; median carina cristulate-sinuate; dorsum profoundly impressed between the shoulders, process behind often angularly excised or narrowly acuminate, often reaching to the apex of the posterior femora; lateral lobes of pronotum distinctly laminate expanded, either obliquely truncate and minutely serrate or erose spiniform. Elytra and wings wanting. Anterior and middle femoral margins strongly lobato-spinose, the tibiae having the superior margins bidentate; posterior femora strongly lobato-spinose, the superior external area plurigibbose, the carinae often bearing produced tubercles or spines; posterior tibial margins armed with spines; first articles of the posterior tarsi subequal in length, the first and second pulvilli minute or subobsolete.

The type is *T. spinifrons*, described herewith. The species *Cladonotus interruptus*, Bolivar, also belongs to this new genus.

1. *T. spinifrons*, sp. nov. (Plate XXII, fig. 4.)

Allied to *Cladonotus interruptus*, Bolivar. Dark ferruginous, little tomentose underneath; vertex nearly twice the width of one of the small globose eyes, bearing a small acute produced spine on each side next to the eyes, projecting much above the eyes; facial carina above depressed, scutellum in profile having the rami strongly angularly protuberant slightly above the point of insertion of the antennae; posterior ocelli placed between the inferior part of the

eyes. Pronotum anteriorly truncate, behind the margin tricarinate, the prozonal carinæ compressed; dorsum forward between the shoulders rather roundly elevated, cristate; median carina strongly sinuate, but continuous throughout; dorsum profoundly fossulate-reticulate; lateral carinæ sinuate and serrulate, bearing spiniform tubercles backward, and near the apex abruptly narrowed acuminate, the apex curved upwards; lateral lobes of pronotum widely laminate expanded, subtransverse, erose, behind produced in spiniform tubercles. Anterior and middle femora strongly trilobate-spinose, superior tibial margins bituberculate; posterior femora having the apices trispinose and bearing a large triangular lobe, the antegenicular spine produced, the superior margins bearing a denticle near the middle, superior area of the external pagina multigibbose or nodulose, the external carinæ armed with one tubercle above and two below distinctly evident when viewed from above; hind tibiæ obscure fuscous with pale annulations near the knee; the third pulvilli of the first tarsal articles flat below, the first and second very small and little acute.

Length of the entire body, 9 mm.; pronotum 7 mm.; posterior femora 4 mm.

One example from Ceylon in the University Museum, Oxford.

Genus GIGNOTETTIX, nov.

(Not in preceding table.)

Related to *Cladonotus*, Saussure, but having the pronotum truncate anteriorly, and destitute of ramose process, the dorsum gibbōse forward in the middle, but not gibbose on each side of summit as in *Cladonotella*; the lateral lobes having the posterior angles somewhat scabrous, laminate and obtuse, truncate obliquely behind, the margins of lobe minutely armed with setæ. Body tomentose, not bearing spiniform tubercles; stature very small, face nearly vertical; vertex very wide, bearing a tubercle on each side next to the eyes, but not acute, middle dentate-carinate produced. Pronotum shortened, truncate anteriorly, the dorsum compresso-gibbose forward, posteriorly flattened declivous, apex truncate-emarginate; prozonal carinæ small and little compressed. Elytra and wings wanting. Anterior and middle femora strongly compressed, margins distinctly lobate, superior tibial carinæ lobate, posterior femora having the proximal half crassate, the distal half reduced, superior external area and external surface below nodulose and scabrous, antegenicular lobes very large, triangular but not acute, the genicular lobes less prominent; first articles of the posterior tarsi little longer than the

third; the first and second pulvilli minute subobsolete, the third longer than the rest.

The type is *G. burri*, described herewith.

1. *G. burri*, sp. nov. (Plate XXII, fig. 5.)

Stature very small, fuscous, body destitute of ramose process and spiniform tubercles, but tomentose and scabrous; vertex very wide, more than twice the width of one of the moderately small globose eyes, trituberculate in front, the middle tubercle little produced, occiput mammiliform on each side; frontal scutellum widely separated concave between the antennæ, the facial costa above between the eyes subobsolete, facial profile advanced beyond the eyes, the rami distinctly protuberant between the antennæ. Pronotum scabrous, anteriorly truncate, between the shoulders compresso-gibbose, the summit slightly sinuate, behind the gibbosity flattened declivous, bearing a tubercle on each side; median carina very uneven; prozonal carinæ abbreviated and somewhat tuberculiform; dorsum over process nearly horizontal; lateral carinæ distinct and armed with minute setæ, apex of process emarginate, not extended to the apices of the hind femora; lateral margins at the middle distinctly elevated and tuberculate. Elytra and wings wanting. Margins of femora armed with minute setæ, superior margin of anterior femora distinctly compressed bilobate, the inferior margins bidentate, the denticle behind the apex prominent, middle femoral margins bi- or trilobate above and below; posterior femora having the external paginæ nodulose, the external carinæ below the middle obtuse tuberculate, the anterior half of femora ampliate, the posterior half reduced, the triangular antegenicular lobe more prominent than the genicular lobes; spines of posterior tibiæ valid; first articles of posterior tarsi little longer than the third.

Entire length of body, male, 7 mm.; pronotum 4.5 mm.; posterior femora 4.7 mm.

One example, No. 9346, from Pundaluoya, Ceylon, collected by E. E. Green; presented by Malcolm Burr to the University Museum, Oxford.

This interesting species is dedicated to the distinguished orthopterist, Mr. Malcolm Burr.

Genus *DASYLEUROTETRIX*, Rehn.

1. *D. currici*, Rehn, Proc. Acad. Nat. Sci. Philadelphia, pp. 658-659, 1904.

Two male examples, Nos. 5836 and 5837, from S.E.

Rhodesia, Africa, Umtali, 3700 ft., October 29, 1905, presented by Guy Marshall; one male from Zambesi, Africa, 3000 ft., Victoria Falls, Rain forest, September 13, 1905, presented by Professor Hudson Beare to the University Museum, Oxford.

All three examples present shorter wings than occurs in the type examples, specimens of which are in the author's collection.

Section *SCELIMENÆ*, Bolivar.

Genus *SCELIMENA*, Serv.

1. *S. producta*, Serv. (?) Hist. Nat. des Orthopt., p. 762, 1839.

A male and female example having no locality given, are doubtfully referred to this species; presented by Malcolm Burr to the University Museum, Oxford.

Genus *EUGAVIALIDIUM*, Hanc.

1. *E. novæ-guinææ*, Bol. (?) Ann. Mus. Civ. Stor. Nat. Genova, Ser. 2, xix, p. 3, 1898.

One female example having no locality, doubtfully referred to this species. This specimen resembles the typical species from New Guinea, in the author's collection. The example in the University Museum, Oxford, bears a label on which is written "E. Mus. Leyden, 1869."

Genus *CRIOTETTIX*, Bolivar.

1. *Criotettix* sp.

One male example, no locality label; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford. A slender species having smooth pronotum, the head compressed, elevated, the eyes globose, and with narrow vertex.

2. *C. angulatus*, sp. nov.

About the size and general form of *tricarinatus*, Bolivar, but having the pronotal carinæ very slightly expressed; the vertex nearly equal in width to one of the eyes, not at all advanced beyond the eyes; the pronotum having the posterior angles of the lateral lobes angulate, subacute but not spined; body fuscous on the dorsum

the anterior and middle femora and sides pale, the hind femora and tibiae fusco-variegated; wings fully explicate passing little beyond the slender process.

Entire length of body, female 12.5 mm.; pronotum 11.5 mm.; posterior femora, 5.5 mm.

The specific name *angulatus* refers to the angulate lateral lobes of pronotum.

One example from Dorey Island, New Guinea, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

The above species was compared with examples of *tricarinatus*, generously contributed to the author's collection by Professor Bolivar.

Genus ACANTHOLOBUS, Hancock.

1. *A. longinotus*, Hancock, Trans. Ent. Soc. London, p. 221, 1907.

Two male examples from Sarawak, Borneo, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

A. bispinosus (Dalm.) (?) Vet. Akad. Hand., p. 77, 1818.

Criotettix bispinosus, Bolivar, Ann. Soc. Ent. Belg. xxxi, p. 226, 1887.

One female example from Borneo, No. 7263, labelled "*Tettix pallitarsus* Walk"; A. De Borman's collection, in University Museum, Oxford.

This example is more slender in stature than the average specimen in the author's collection from Java, and it is not typical; it differs in the somewhat narrower vertex, and the less acuminate spines of lateral lobes. It resembles *longinotus* in stature, but the posterior angles of lateral lobes differ in bearing acuminate spines, still not so produced as in *bispinosus*. For the reasons just given it is questionably referred to this species until further specimens come to hand.

3. *A. miliarius* (Bolivar), Ann. Soc. Ent. Belg. xxxi, p. 226, 1887.

One example from Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

Genus LOXILOBUS, Hancock.

1. *L. rugosus*, Hancock, *Spolia Zeylanica*, ii, pp. 135–136, Plate III, figs. 17–17*b*, 1904.

Two male and one female (No. 9470) examples from Pundaluoya, Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

This species has characters assigning it a place near *Coptotettix*.

Genus SYSTOLEDERUS, Bol.

1. *S. ridleyi*, sp. nov.

Body cinereous, the posterior tibiæ fuscous, pale annulate behind the knee and at the middle; head scarcely exerted; vertex strongly narrowed, subelevated forward; eyes strongly approximate in front, moderately prominent; frontal costa not at all sinuate, and not produced, moderately compressed between the antennæ. Pronotum smoothly granulate, convex between the shoulders; median carina scarcely at all expressed and obliterated behind the anterior margin; anterior prozonal and humero-lateral carinæ subobliterated; apical process extended little beyond the apices of posterior femora, the three carinæ above posteriorly little distinct; lateral lobes oblique below and little reflexed outwards, the posterior angles obtuse, obliquely excised behind. Elytral apices very narrowly rounded, though moderately wide at the middle; wings reaching to the apex of pronotal process. Anterior and middle femora compressed, the length of the middle femora equal to about three and a half times the width; the third pulvillus of the posterior tarsi little longer than the rest.

Entire length of body, female, 11·8 mm.; pronotum 11 mm.; posterior femora 5·8 mm.

One example from Singapore Botanical Gardens. This species is dedicated to Mr. H. N. Ridley, who collected and presented the type example to the University Museum, Oxford. This species is closely allied to *S. cinereus*, Brunner, described from one example from Burmah (in *Rev. du Syst. Orthopt.*, p. 105, Genova, 1893).

Genus MORPHOPUS, Bolivar.

1. *M. folipes*, sp. nov.

Resembling *phyllocerus*. Body bearing compressed carinæ, scabrous, colour light ferruginous or rufous fusco-variegated, eyes fuscous,

dorsal disc behind the shoulders fusco-bimaculate; vertex narrower than one of the eyes in the male, subequal in the female, little narrowed forward, transversely carinate, the carinulae rather roundly compresso-elevated on each side, middle lightly carinate, in profile not advanced beyond the eyes; frontal costa arcuately elevated between the antennae, rather widely sulcate, the rami straight; antennae short and not as long as the head, inserted distinctly below or anterior to the eyes. Pronotum depressed, anteriorly truncate, dilated between the distinct humeral angles, carinae laterally little compressed just behind the shoulders, the subulate apical process lengthily extended backward beyond the posterior femoral apices; dorsum rugose tuberculate, between the shoulders bearing abbreviated carinulae; median carina bicristate forward, strongly sinuate just before the shoulders, the forward crest often little higher than the second elevation; median carina posteriorly very little compressed and straight, minutely serrate; lateral carinae strongly compressed at the shoulders, posteriorly on the process serrulate; prozonal carinae, short, little expressed and parallel; posterior angles of the lateral lobes distinctly flattened quadrate, the posterior angles obtuse, behind obliquely truncate. Elytra oval; wings fully explicate, extended backward beyond the pronotal process in the female, or not at all in the male. Anterior femora strongly compressed, margins above sinuate, below foliaceo-trilobate, the middle lobe large with sinuate margin; posterior femora scabrous and having the external area between the carinae tuberculose, the external carinae bidentate or lobate in the female; hind tibiae fuscous marked with white at the middle and near the knees; first article of the posterior tarsi longer than the third, the third pulvilli little longer than the rest.

Entire length of body, male and female, 9·8–11·5 mm.; pronotum 9–10·5 mm.; posterior femora 4–4·5 mm.

One male and one female example from Salisbury, 5000 ft., in Mashonaland, taken November 11, 1905; presented by Mr. Guy Marshall to the University Museum, Oxford.

Genus PLATYTETTIX, Hancock.

1. *P. reticulatus*, Hancock, Ent. News, Philadelphia, p. 88, 1906.

One male and one female; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

The female example bears the locality Amazon, and was

collected by Bates; the second male example is also from Brazil. The former specimen has the pronotum little more highly arcuate-cristate than the type specimen in the author's collection, from Peru, besides having the apex of the process more obtuse. Until more material is examined these minor structural differences will be ignored as being of no specific importance. This species was figured by the author in *Genera Insectorum*, Fasc. 48 Orthopt., Plate III, fig. 23, 1906.

Genus CRIMISUS, Bolivar.

1. *C. lobatus*, sp. nov.

Body rather crassate; head little exserted; eyes and vertex small; posterior femora strongly incrassate but somewhat depressed, flattened below; colour greyish-ferruginous, obscure fusco-variegated, disc of pronotum rufous. Vertex equal in width to one of the eyes, subwidened forward, the anterior carinulæ slightly roundly lobulate, median carina very small and anteriorly barely produced; frontal costa convex protuberant between the antennæ, slightly sinuate above and below, rather widely sulcate, the rami straight; pronotum distinctly widened between the humeral angles, dorsum scabrous, behind the shoulders strongly depressed, fossulate, sides little compressed; median carina sinuate and pluri-interrupted, between the shoulders little elevated, sinuate, before the shoulders compresso-elevated, posteriorly bearing a series of small compressions; process acute, not reaching to the apices of the hind femora; lateral carinæ of pronotum little compressed and entire. Pronotum planate between the prozonal carinæ; humeral angles distinct and obtuse; lateral lobes flattened, quadrate, the posterior angle obtuse, behind obliquely truncate. Elytra elongate, apices acuminate; wings abbreviated. Superior carinæ of anterior femora undulate, inferior carinæ sinuate, bearing a lobe at the outer third; superior margin of middle femora undulate; the inferior carina trilobate; posterior femora having the superior carina strongly arcuate, dentate towards the apices; first articles of posterior tarsi having the first two pulvilli acute, the third little longer than the rest and flat below.

Length of body entire, female, 8 mm.; pronotum 7.5 mm.; posterior femora 5 mm.

One example from Amazon, South America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

This species resembles *C. contractus*, Bol., a Peruvian form.

Genus LAMELLITETTIX, Hancock.

1. *L. acutus*, Hancock, *Spolia Zeylanica*, ii, pp. 126-128, Plate II, fig. 6-6b, 1904.

One male example, No. 9399, from Havahetta, Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

This species was described from a female example from Ceylon. The entire length of the male measures 12 mm. from front to end of pronotal process.

2. *L. pluricarinatus*, sp. nov.

Body slender, ferrugino-fuscous. Head very little exerted; vertex subnarrower or equal to one of the rather small eyes, frontal carinulae on each side barely elevated, oblique, subtuberculiform; frontal costa compressed above between the eyes and the rami protuberant between the antennae; posterior ocelli conspicuously placed between the lower third of the eyes. Pronotum moderately narrow between the humeral angles, depressed on the process; dorsum pluricarinate; median carina irregularly sinuate, bicompressed forward and posteriorly depressed but irregularly compressed; dorsum between the shoulders bearing two supplemental abbreviated carinulae running parallel and compresso-elevated; prozonal carinae and lateral carinae in front of the shoulders distinctly expressed; posterior process acuminate prolonged reaching beyond the apices of the outstretched hind tibiae; posterior angles of lateral lobes, laminate subacute, angulate, behind little subexcavate but widely and obliquely truncate. Elytral apices rounded; wings fully explicate nearly reaching to apex of pronotal process. Anterior and middle femora elongate; third pulvilli of the first posterior tarsal articles nearly as long as the first and second combined and flat below; the first and second subacute; posterior tibiae infuscated backward towards the apices.

Entire length of body, female, 14.6 mm.; pronotum 13.5 mm.; posterior femora 5.2 mm.

One example from Deltota, Ceylon, No. 9393, presented by Malcolm Burr to the University Museum, Oxford.

This species is easily recognized by the small vertex, the slender body bearing an extremely acuminate pronotal process, and the laminate, subacute, angulate, lateral lobes, instead of the acute transversely produced angles in *acutus*.

Genus MAZARREDIA, Bolivar.

1. *M. sculpta*, Bolivar, Ann. Soc. Ent. Belg., xxxi, p. 240, 1887.

One female example referable to this species, from Assam, India, in the University Museum, Oxford.

The pronotal process is mutilated in this specimen; the hind femora measures only 7 mm. instead of 8·5 mm., given by Bolivar, but it agrees with the description of this insect.

2. *M. dorrea*, sp. nov.

A small abbreviated apterous form, coloured testaceous variegated with fuscous. Resembling the allied species *abbreviata*, Bolivar, inhabiting the Island of Viti. Vertex viewed from above convex at the front border, wider than one of the eyes, little widened anteriorly, the transverse carinulæ subacutely elevated between the anterior third of the eyes, the sides sinuate, median carina little produced; frontal costa scutelliform, little elevated, viewed in front concave, abruptly widened below between the antennæ and strongly compresso-narrowed between the posterior ocelli. Pronotum abbreviated, dorsum scabrous, pluri-impressed but broadly fossulate at the base of the short process, anteriorly subtectiform, humeral angles obsolete, the apex of obtuse process barely emarginate; median carina percurrent biundulate, forward before the shoulders and posteriorly on process convexly elevated, lateral lobes having the posterior angles quadrate, obliquely truncate behind, the angles little reflexed outwards. Anterior and middle femora compressed, superior carinæ of anterior femora entire, longitudinally convex, below triundulate, sublobate; superior carinæ of middle femora obscure undulate nearly straight, the inferior carinæ triundulate-lobate; posterior femora somewhat depresso-incrassate, margins entire, the antegenicular and apical lobes acute; the three pulvilli of the first tarsal articles nearly equal in length.

Entire length of body, female, 9·5 mm.; pronotum 6·5 mm.; posterior femora 5 mm.

One example from Dorey Island, New Guinea, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus ORTHOTETTIX, nov.

Related to *Mazarredia*, Bolivar, but having the body smoothly granulate, vertex narrow, the transverse carinulæ strongly oblique

and straight extending backward to the middle of the eyes ; middle carinate ; frontal costa arcuate, in profile not sinuate, the rami branching little above the posterior ocelli, widely sulcate ; posterior ocelli placed between the lower third of the eyes ; antennæ filiform rather short, scarcely reaching to the humeral angles, inserted distinctly between the eyes. Pronotum deplanate, fossulate at the base of process, between the shoulders convex ; process of pronotum extended backward beyond the apices of the posterior femora ; lateral lobes having the posterior angles turned down, obtuse. Femora elongate, margins entire. Elytra oblong, apices rounded ; wings fully explicate ; first articles of the posterior tarsi rather longer than the third.

Type *O. obliquifrons*, sp. nov., herewith described.

1. *O. obliquifrons*, sp. nov. (Plate XXII, fig. 6.)

Body slender, granulate, colour cinereous very obscurely variegated with fuscous on sides and legs ; eyes globose ; vertex viewed in front subnarrower than one of the eyes, viewed from above bearing strongly oblique carinulae convergent forward and extended backward on each side to the middle of the eyes, the vertex here a little widened, middle carinate, on each side somewhat foveate ; frontal costa arcuate, viewed in front rather widely sulcate, the rami evenly divergent. Pronotum anteriorly truncate, posteriorly lengthily acuminate subulate, extended much beyond the apices of the posterior femora ; dorsum deplanate, bearing two indistinct, abbreviated granulate carinulae between the shoulders ; median carina very thin but little incrassate between the shoulders, here undulate then depressed behind, and straight on the process and less distinct ; prozonal carinae parallel, very lightly expressed ; lateral carinae passing forward on the shoulders but indistinctly expressed ; humeral angles having the carinae more expressed, widely angulate ; posterior angles of lateral lobes turned down, obtuse. Elytra oblong having rounded apices ; wings fully explicate reaching to apex of pronotum in male. Anterior and middle femoral margins entire ; posterior femora elongate, the prægenicular lobe small, spiculate, the genicular lobe minute ; posterior tibiae armed with small spines and serrulate ; the first articles of the posterior tarsi little longer than the third, and having the pulvilli flat below, the third longer than the second.

Entire length of body, male, 13 mm. ; pronotum 12 mm. ; posterior femora 6 mm.

One example from Sarawak, Borneo, collected by

Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus CRYPTOTETTIX, Hancock.

1. *C. spinilobus* Hanc., Occas. Memoirs Chicago Ent. Society I, No. 1, pp. 14-15, Pl. I, fig. 6-6b, 1900.

One female example, No. 9426, without a locality label; presented by Malcolm Burr to the University Museum, Oxford.

This species inhabits Madagascar.

Genus THORADONTA, nov.

Related to *Macarredia*. Body scabrous, occiput covered by pronotum to the eyes, head not exerted; stature small, yet somewhat stout. Vertex distinctly wider than one of the eyes, not advanced beyond the eyes, scarcely at all narrowed forward, somewhat imperfectly carinate in front but bearing little abbreviated carinulae on each side, median carina little distinct forward and little produced, on each side subfossulate, frontal costa moderately sulcate, the rami evenly divergent, branching little behind the posterior ocelli near the vertex, posterior ocelli placed between the middle or barely below the middle of the eyes; maxillary palpi having the apical articles little compressed, often white; antennae somewhat elongate, inserted below the eyes. Pronotum scabrous, deplanate on the dorsum, anteriorly truncate, posteriorly acute but not spinate, not extended backward to apices of hind femora or little beyond; median carina strongly compresso-sinuate; dorsum between the carinated humeral angles little dilated and bearing a supernumerary abbreviated carinula on each side; lateral carinae behind the shoulders often little compressed and elevated above the elytra. Elytra oval; wings abbreviated or nearly perfectly explicate. Lateral lobes of pronotum having the posterior angles distinctly laminate expanded and produced in a spine or acute dentate, subtruncate behind. Anterior femora above carinate, below subundulate; middle femoral margins above undulate, below undulate-sublobate; posterior femoral margins arcuate above and below, entire or minutely serrulate, the prægenicular and genicular lobes small, posterior tibiae somewhat dilated towards the apices, margins spinose; the first and third articles of the posterior tarsi subequal in length.

Type *T. dentata*, described herewith.

There are two species characterized as follows :

1. Lateral lobes having the posterior angles obliquely dentate produced. Species from Penang Island. *T. dentata*, sp. nov.
- 1.1. Lateral lobes having the posterior angles distinctly acute spinate produced, spine transverse. Species Africana, *T. spinata*, sp. nov.

1. *T. dentata*, sp. nov.

Body small, variegated with fuscous, head not at all exserted ; eyes globose but rather small and not at all elevated ; vertex much wider than one of the eyes, advanced nearly as far as the eyes, little fossulate on each side, middle carina little crassate forward and little produced, frontal costa in profile little protuberant between the antennæ, scarcely sinuate above and below ; posterior ocelli placed between the middle of the eyes. Pronotum scabrous, deplanate, somewhat convex between the shoulders ; process acute not reaching to the apices of posterior femora ; median carina sinuate bicristate, roundly compresso-elevated anteriorly above the sulci, subtuberculate on the process ; dorsum between the humeral angles little dilated, the angles distinctly carinate, little compressed, obtuse angulate, just behind the shoulders over the elytra the lateral carinæ compresso-elevated and here sinuous, here also at the base of process the dorsum fossulate and fuscous ; abbreviated carinæ between the shoulders compressed ; posterior angles of the lateral lobes laminate, flattened, acute dentate produced, behind the denticles obliquely truncate. Elytral apices widely rounded ; wings barely passing the process. Posterior femora little incrassate, margins entire ; the second and third pulvilli of the first tarsal articles equal in length, the first small and spiculate below.

Entire length of body, female, 7 mm. ; pronotum 6 mm. ; posterior femora 4 mm.

One example from Prince of Wales Island (or Penang), in the University Museum, Oxford.

2. *T. spinata*, sp. nov. (Plate XXII, fig. 7.)

Nearly allied to the preceding species, resembling it in stature and general form ; colour grey ; vertex wider than one of the eyes ; head not at all exserted ; frontal costa strongly protuberant between the antennæ, scarcely at all sinuate between the eyes ; maxillary palpi having the apical articles white. Pronotum having the posterior angles of the lateral lobes strongly laminate, transversely acute spinate produced. Pulvilli of the first posterior tarsal articles

nearly equal in length, but the first and second acute; middle femora ampliate toward the bases in the male.

Entire length of body, male, 7 mm.; pronotum passing apices of hind femora 5 mm.; posterior femora 3·8 mm.

One example from "Equinoctial Africa," in University Museum, Oxford.

Genus XISTRA, Bolivar.

1. *X. stylata*, Hancock, Trans. Ent. Soc. London, p. 231, 1907.

One male example from Kandy, Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

The type example, a female, is in the author's collection. It is from Putlam, Ceylon.

Section TETTIGIÆ.

Genus EUPARATETIX, Hancock.

1. *E. personatus*, Bol. Ann. Soc. Ent. Belg. xxxi, p. 278, 1887.

Two male examples; one from Bengal, India; the other from Java, the latter specimen collected and presented by J. W. Miers to the University Museum, Oxford.

Two characters which distinguish this species are: the fuscous or black posterior tibiæ which bear one white annulation behind the knee, and the arcuate frontal costa which is narrowly compressed. At first sight this species recalls the genus *Systolederus*.

2. *E. pilosus*, sp. nov.

Resembling *personatus*. Head little compresso-elevated; eyes elevated above the dorsum; vertex narrower than one of the eyes; narrowed forward, not at all produced beyond the eyes; frontal costa convexly protuberant between the antennæ, little sinuate between the eyes (not arcuate as in *personatus*) the rami somewhat evenly divergent, moderately sulcate. Pronotum slightly scabrous, often fusco-bimaculate behind the disc; forward at the anterior margin and just behind the prozona constricted; median carina undulate, little compresso-elevated behind the anterior margin; humeral angles carinate, dorsum between the shoulders subconvex; posterior process lengthily subulate extended much beyond the posterior femoral apices; posterior angles of the lateral lobes rounded. Elytra oval,

apices widely rounded; wings caudate. Anterior and middle femora distinctly compressed, entire, (wider in the male) the inferior carinae of middle femora distinctly pilose, middle tibiae having the carinae little compressed and distinctly pilose; posterior femora elongate, having margins entire or minutely serrulate above, the femoral lobes minute; the three pulvilli of the first posterior tarsal articles equal in length and spiculate below; posterior tibiae fuscous bearing a white annulation behind the knee, and a second smaller ring at the distal third part. Body variably coloured, often greyish or rufo-cinereous variegated with fuscous.

Entire length of male and female (to end of wings) 11-12 mm.; pronotum 9.5-10 mm.; posterior femora 4-4.5 mm.

Three male examples from Mysore, India; one male with label bearing words "Central India," and a female with simply "India," collected by Hearsey; University Museum, Oxford.

This species is distinguished from *personatus* by the lightly sinuate frontal costa, the undulate median carina of pronotum, the more scabrous dorsum, the spiculate pulvilli of the first tarsal articles, the more compressed anterior and middle femora, and the hirsute or pilose inferior carinae of middle femora and the compressed hirsute carinae of middle tibiae.

Genus PARATETTIX, Bolivar.

1. *P. scaber*, Thunb. Nov. Act. Ups. vii, p. 159, 1815.

= *Telmatettix burri*, Hanc. Occas. Memoirs Chicago Ent. Soc. I, No. 1, p. 10, fig. of male 5-5a, Plate I, 1900.

Three females, two males, and one immature, Nos. 10587-10590, 10791, and 3950. Five of this number are from Mombasa, Africa, 12 miles N.W. of Mazaras, 500 ft., Sept. 23, 1905, collected and presented by Prof. E. B. Poulton to the University Museum, Oxford. No. 3950, is from Natal, Durban, Feb. 11, 1905, collected and presented by G. F. Leigh to the Museum.

Karny has recently described a short-wing form of this species as *P. ugandensis* in Mathem. naturw. Klaase Bd. cxvi, Abt. 1, Feb., p. 26, 1907; "Orthopterenfauna des Sudans." There is one male specimen long-wing form, No. 4750, in the University Museum, which appears to be a variety of *scaber*; it is from Salisbury, 5000 ft., Mashonaland, collected by Mr. Guy Marshall.

2. *P. marshalli*, sp. nov.

Resembling *scaber*, but smaller in stature, having the vertex together with the frontal costa in profile distinctly arcuate, not at all sinuate, the antennæ short, articles not strongly elongate, the median carina of pronotum percurrent, little elevated, entire.

Entire length of body, male, 9 mm.; pronotum 7.5 mm.; posterior femora 4 mm.

The antennæ are inserted between the lower part of the eyes in this species, as they are in *scaber*. Were it not for the narrow truncate front margin of the vertex, *marshalli* might better be assigned a place in the genus *Hedotettix*, as the other characters referred to above ally it with the latter.

One example from Cape Town, Rondebosch, Aug. 17, 1905, collected and presented by Mr. Guy Marshall to the University Museum, Oxford.

The author takes pleasure in naming this species after Mr. Marshall.

3. *P. shelfordi*, sp. nov.

A short-wing form slightly scabrous, colour ferruginous obscurely fusco-bimaculate on the dorsum. Vertex slightly narrower than one of the eyes, fossulate on each side anteriorly; eyes little elevated; frontal costa rather flattened convex in profile between the antennæ and not sinuate between the eyes, widely sulcate, the rami evenly divergent. Pronotum abbreviated, cuneate posteriorly, and laterally bicarinate on process, the apex not reaching to apex of abdomen in the female; humeral angles subindistinct; prozonal carinæ not at all expressed; dorsum subtectiform forward, depressed behind the shoulders; median carina undulate; posterior angles of the lateral lobes widely rounded. Elytra of moderate size, widely rounded at the apices; wings abbreviated, only as long as the pronotal process. Anterior and middle femora compressed, somewhat hirsute; superior valves of female ovipositor strongly broadened towards the bases, acute, produced toward the apices and armed with denticles.

Entire length of body, female, 8 mm.; pronotum 6.5 mm.

One example, No. 1236, from Malay peninsula, Perak, Larut Hills, 4-5000 ft., collected and presented by Mr. R. Shelford to the University Museum, Oxford.

The legs are mutilated in the type specimen.

This species is dedicated to Mr. R. Shelford, the discoverer of the type example.

Genus TETRIX, Lat.

1. *T. contractus* (Bol.) Ann. Soc. Ent. Belg. xxxi, p. 281, 1887.

= *Paratettix contractus*, Bol.

One male and one female, examples from Singapore collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum.

This species also inhabits the Philippines and Borneo.

2. *T. longipennis*, sp. nov.

A typical *Tetrix* having long wings and subulate pronotal process. Stature small, body somewhat scabrous-tuberculate in the female, smoother granulate in the male; colour variable, more often fuscous, sometimes greyish or testaceous or dark covered with light granulations, disc not maculate, variably marked behind, hind tibiæ infuscated more often lighter behind the knees and distal third part. Vertex wider than one of the rather small eyes, somewhat flattened, front margin barely advanced beyond the eyes, rounded or convex, median carina little produced anteriorly; frontal costa slightly sinuate opposite the eyes, lightly convex between the antennæ; in profile the vertex and facial costa distinctly advanced beyond the eyes. Pronotum often scabrous, anteriorly truncate, posteriorly subulate, extended beyond the femoral apices; dorsum transversely tectiform, subfossulate at base of process; median carina compressed subarcuate anteriorly often undulate in the female, nearly entire in the male; humeral angles carinate; prozonal carinæ parallel, slightly expressed; lateral lobes posteriorly bisinuate, the posterior angles rounded or hebetate. Elytra oval, rather large, apices somewhat widely rounded; wings fully explicate extended beyond the apex of pronotal process. First articles of posterior tarsi twice the length of the third, the pulvilli unequal, the third equal in length to the first and second combined, straight below, the first pulvilli small, acute; anterior femora elongate margins entire; middle femora compressed, in the female the margins undulate, in the male the femora ampliate, margins entire; posterior femora elongate.

Entire length of body, male and female, 9·5–11 mm.; pronotum 8·5–9·5 mm.; posterior femora 4·5–5 mm.

Five examples from Adelaide, S. Australia, in the University Museum, Oxford.

Two examples from Mt. Wellington, Tasmania, collected

by Lea, in the author's collection. The two latter specimens are slightly smaller but agree in other respects with the foregoing description.

This species resembles *Tetrix ornata*, Say, inhabiting North America.

2a. *T. longipennis mutabilis*, form nov.

There is a small short-wing form of *longipennis* from the same localities, which may be given the appellation above noted. It is similar to the preceding form, the body bearing elytra but having the pronotal process and wings abbreviated, not or barely reaching to the apices of the posterior femora.

Entire length of the body, male and female, 7-8 mm.; pronotum 6.5-7.8 mm. ; posterior femora 4.8-5 mm.

Nine adults and three larvæ from Adelaide, Australia, in the University Museum, Oxford.

Eight examples from Victoria, Australia, in the author's collection.

The form *mutabilis* is nearly allied to *priscus*, Bol., and may possibly be that species, but if so, Bolivar must have described his species from an immature example.

3. *T. variegatus* (Bol.) Ann. Soc. Ent. Belg. xxxi, p. 106, 1887.

= *Paratettix variegatus*, Bolivar.

Two female examples from Java referable to this species. Example No. 9332 from East Java, Montes Tengger, 4000 ft.; presented by Malcolm Burr to the University Museum, Oxford.

This species was originally described from Ceylon examples. The head is more compresso-elevated than in *Tetrix cuspidata*, Hancock, from Java. The exerted head and elevation of the vertex toward the front allies this species with *Euparatettix*, yet other characters are peculiar also to both *Tetrix* and *Paratettix*.

4. *T. ornata*, Say, Ent. i, p. 137; Plate V, 1824.

One male and one female example from America; one from "U. S."; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

5. *T. granulata*, Kirby, Fauna Bor. Amer. Ins. p. 251, 1837.

One female example from America (in all probability N. America) in the University Museum, Oxford.

The following species of American *Tetrix* and *Nomotettix* are characterized by an obtuse-conical profile to head; the frontal costa between the eyes not at all or barely excavate. These insects are labelled briefly "Amer. b." which Mr. Shelford interprets as *America borealis*.

6. *T. americana*, sp. nov.

A robust long-wing form of the *granulata* series; body granulate, the vertex not so angulate produced as usual, but formed in an obtuse-rounded angle in profile and not at all or indistinctly sinuate between the eyes; colour dark variegated with fuscous. Head not exserted; vertex wider than one of the moderately sized eyes, equal to about one and a half times, little narrowed forward, the front margin somewhat angulate but not so produced as in *granulata*; frontal carinulae rounding posteriorly into the sides, little compressed; median carina compressed, extended the length of vertex, in profile elevated above the eyes and produced and rounded anteriorly; frontal costa dividing behind the posterior ocelli near the apex, rather widely sulcate, the rami evenly divergent, in profile not at all sinuate between the eyes or rarely subexcavate, the facial costa strongly advanced beyond the eyes; posterior ocelli conspicuously placed free in advance of the middle of the eyes. Pronotum granulate, truncate anteriorly, posteriorly subulate, the process extended beyond the apices of the posterior femora; dorsum tectiform, somewhat broad between the humeral angles; median carina little compressed percurrent, somewhat arcuate forward nearly straight posteriorly; lateral carinae moderately expressed; prozonal carinae slightly expressed and subdivergent posteriorly; lateral lobes having the posterior sinus above shallow; posterior angles rounded. Wings fully explicate; elytra oval, the apices rounded. Femoral margins entire; the first articles of the posterior tarsi nearly twice the length of the third; the third pulvilli flat below and equal in length to the first and second, acute.

Length of body entire, female, 15 mm.; pronotum 11·8 mm.; posterior femora 5·6 mm.; wings passing the pronotal apex 2 mm.

One example from "Amer. b." North America; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

6a. *T. americana dimorpha*, form nov.

A smaller less robust form, having short wings and abbreviated pronotum, but having other characters similar to the preceding. The frontal costa very little sinuate between the eyes, in profile the vertex obtuse angulate, not so acute as in *brunneri* or *granulata*, and easily distinguished from either of these and other N. American *Tetrix*. The dorsum smoothly granulate, the elytra small, the apices narrowly rounded, the pronotal process posteriorly acute, not reaching to the apex of posterior femora; wings shorter than the pronotal apex.

Entire length of body, male and female, 8-10 mm.; pronotum 7-8 mm.; posterior femora 5.3-6.8 mm.

Four examples from the same collection as the preceding, and from the same locality.

Genus *NOMOTETRIX*, Morse.

1. *N. validus*, sp. nov.

Distinguished from all the other species by the stouter form in the female, the obtuse conical vertex in profile, strongly produced beyond the eyes, and the absence of excavation of frontal costa between the eyes. Body granulate, colour variable as in *cristatus*. Vertex nearly twice the width of one of the eyes, viewed from above obtuse angulate produced beyond the eyes, the frontal transverse carinulæ on each side roundly flexed or bent backward, little compressed; vertex narrowed forward but little ampliate between the carinulæ, on each side foveate, posteriorly mammillate, median carina somewhat incrassate, prominent, in profile elevated above the eyes and arcuate, anteriorly roundly produced; frontal costa widely sulcate, in profile united with the vertex, strongly obtuse-conical, not at all excavate between the eyes, declivous below, and at the median ocellus barely sinuate; vertex advanced beyond the eyes, equal to about four-fifths the width of one of the eyes; posterior ocelli conspicuously placed, uncovered midway between the frontal costa and front margin of the eyes. Pronotum compresso-cristate, the front margin obtuse angulate produced over the head, not so acute as in *cristatus*; median carina arcuate forward, dorsal margin straight between the humeral angles and somewhat convexly sloping posteriorly; humeral angles widely rounded; process posteriorly cuneate, extended backward nearly to the apices of the posterior femora; the superior sinus of lateral lobes shallow, posterior angles narrowly rounded. Elytra elongate, apices very narrowly rounded

or subacute ; wings abbreviated, undeveloped. Anterior and middle femora elongate, compressed, margins entire ; posterior femora elongate, superior margin arcuate forward, flattened posteriorly and minutely serrulate the antegenicular lobe of moderate size ; first articles of the posterior tarsi nearly twice the length of the third, the pulvilli straight below, the first small, the second and third elongate and subequal in length.

Entire length of body, female, 11 mm. ; pronotum 8·8 mm. ; posterior femora 6·5 mm.

Two female examples from N. America ; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

2. *N. arcticus*, sp. nov.

A long-wing form, slender in stature, resembling *validus* in the vertex and frontal costa, but the head presents a more rounded-obtuse conical profile, the pronotum somewhat narrower between the shoulders, the median carina thinly compresso-elevated, arcuate forward of the humeral angles and subulate posteriorly, extended backward beyond the apices of the posterior femora, wings fully explicate passing the apex of pronotal process, the first articles of posterior tarsi having the first and second pulvilli little flattened below but the apices acute, and the third pulvilli little longer than the second, and distinctly flattened below.

Entire length of body, female, 13 mm. ; pronotum 10·5 mm. ; posterior femora 5 mm.

Two female examples from N. America ; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

This species is at once distinguished from *carinatus* by the more tumid face and vertex, which presents a rounded obtuse-conical profile, the absence of excavation between the eyes of the frontal costa, and the more obtuse angulate front margin of pronotum.

2a. *N. arcticus obtusus*, form nov.

A short-wing form, probably of *arcticus*. Body small, granulate ; vertex having the front margin convex, median carina produced ; profile of head obtuse-conical ; frontal costa not at all excavate between the eyes. Pronotum having the front margin obtuse angulate, dorsum somewhat narrow between the shoulders ; humeral angles widely obtuse, the posterior process abbreviated acute, not

reaching backward to the knees of the hind femora ; median carina strongly compresso-cristate, arcuate forward before the humeral angles, sloping substraight posteriorly ; posterior angles of lateral lobes obtuse. Elytra small, apical margin rounded ; wings shorter than the process. Femoral margins entire ; middle femora in male somewhat ampliate ; first articles of posterior tarsi having the first two pulvilli acute, the third pulvilli elongate and longer than the third and flat below.

Entire length of body, male (to end of hind femora), 8.5 mm. ; pronotum 6.5 mm. ; posterior femora 4.5 mm.

One male example from N. America ; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus *PROTOTETTIX*, Bolivar.

1. *P. africanus*, sp. nov.

Body crassate, scabrous, strongly tuberculate, colour ferruginous variegated with fuscous, anterior and middle tibiæ pale annulate. Head not all exerted, face tumid below the eyes ; vertex narrowed forward, wider than one of the eyes, fossulate on each side and bearing small supraocular lobes and rounded frontal carinulæ, middle indistinctly carinate ; frontal costa narrowly compressed, convex between the antennæ, barely sinuate between the eyes, face below sinuate ; antennæ inserted between the lower forward part of the eyes. Pronotum incrassate, convex between the shoulders, and planate behind ; dorsum tuberculose-scabrous ; humeral angles widely obtuse ; posterior process cuneate extended backward nearly to the knees of the hind femora ; median carina strongly irregularly sinuato-interrupted, compresso-elevated forward between the sulci ; prozonal carinæ obscure, tuberculate ; lateral lobes having the inferior margin little reflected outwards, the posterior angles narrowly subobliquely excised. Elytra small, narrow, the apices subacutely rounded ; wings abbreviated. Anterior femora elongate, the inferior margins indistinctly bidenticulate ; middle femoral margins minutely tridentate ; posterior femora elongate, margins minutely undulate-dentate, external paginæ above strongly longitudinally nodulose, the oblique rugæ externally strongly expressed ; hind tibiæ strongly incrassate, the external carinæ expanded and distinctly armed with spines ; the first articles of the posterior tarsi much longer than the third, the first two pulvilli angulate acute, the third longer than the second, flattened below.

Entire length of body, female, 13.5 mm. ; pronotum 11 mm. ; posterior femora 7.8 mm.

One adult example and five larvæ from S.E. Rhodesia, Melsetter, Gazaland, 3000 ft. Mount Chirinda, "in the forest," October 6, 1905, collected and presented by Guy Marshall to the University Museum, Oxford.

This species resembles *impressus*, differing in the shorter pronotum, and the entire lateral carinæ at the humeral angles, but behind on the process strongly interrupted, irregular, and disappearing backward before the apex. In *impressus*, according to Bolivar, the lateral carinæ present a crenulate margin and the pronotum measures 14 mm. instead of 11 mm. as given above.

Genus RYTINATETTIX, nov.

Resembling *Prototettix*, Bolivar, but having the stature very small, rugose-tuberculose, the posterior ocelli placed below the middle of the eyes; the vertex wider than one of the moderately small eyes, the frontal costa widely sulcate; the antennæ inserted little before (below) the eyes, the inferior lateral margins of pronotum above the insertion of the elytra sinuate or arcuately excavate; the elytra minute or small; wings abbreviated, the lateral lobes of pronotum little reflexed outwards, somewhat widely rounded and obliquely truncate or hebetate; the anterior and middle femora compressed, margins undulate-lobate, the posterior femora somewhat incrassate, and the first articles of the posterior tarsi little longer than the third.

The type is *Prototettix fossulatus*, Bolivar. To this genus also belongs the species *Prototettix lobulatus* (Stål.), Bol., both inhabiting South America. The creation of the new genus, *Rytinatettix*, leaves only the African species remaining in Bolivar's genus *Prototettix*, namely, *P. impressus* (Stål.), Bol., and *P. africanus*, Hancock. Giglio-Tos* described a species under the name *Paratettix borellii*, which appears to be synonymous with *Rytinatettix lobulatus* (Stål.).

1. *R. fossulatus*, Bol., Ann. Soc. Ent. Belg. xxxi, p. 251, 1887.

Two male examples from Rio Grande do Sul, Nos. 9258-9259, presented by Malcom Burr to the University Museum, Oxford.

These examples were previously determined by Brunner as "*Paratettix toltecus*," Saussure. The latter species, so

* Boll. Mus. Torino xii, No. 302, p. 28, 1897.

far as the author's experience goes, does not inhabit South America, but is confined to Mexico and South-Western United States. *R. fossulatus* is distinguished from *P. toltecus* by the broader vertex, the rugose-tuberculate pronotum, and the minute elytra, which are sometimes partially hidden by the inferior lateral margin of the pronotum.

2. *R. lobulatus* (Stål), Freg. Eug. Res. Ins. Orthopt., p. 347, 1860 = *Tetrix lobulata* (Stål) and *Paratettix lobulatus* (Stål), Bolivar, and *Paratettix borellii*, Giglio-Tos. See *ante*.

One male example collected by Bates on the Amazon, South America; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus TETTIELLA, nov.

Resembling *Prototettix*, Bolivar, but having the stature small, the eyes very small; the vertex wide, little narrowed forward, more or less advanced beyond the eyes, anteriorly the transverse carinulae roundly flexed backward on each side, sulcate on each side of median carina, fossulate forward but mammillate posteriorly on each side of occiput. Pronotum anteriorly angulate produced over the head, between the shoulders often tumid, the humeral angles wanting or obsolete, posteriorly the process abbreviated, the apex obtuse or emarginate, not extended backward to apices of the posterior femora, the posterior angles of lateral lobes turned down but more or less obliquely excised or subrounded. Elytra and wings wanting. First articles of posterior tarsi much longer than the third.

The type is *T. arcuata* described herewith. To this genus also belongs: *Tettix dubiosus*, Bol., *Tettix latipes* (Stål), and *Tettiella conofrons*, Hancock, described further on.

1. *T. arcuata*, sp. nov.

Body small, somewhat tumid, strongly rugose-tuberculate, conspersed with pale granulations, colour pale variegated with fuscous, disc of pronotum having a pale tumose excrescence. Vertex wide, equal to twice the width of one of the eyes, narrowed forward, the front margin little advanced beyond the eyes, convex, sulcate on each side of the median carina, fossulate forward and mammillate posteriorly on each side of the occiput, in profile the vertex little elevated

and advanced beyond the eyes; frontal costa moderately sulcate, the rami evenly divergent, in profile convexly protuberant between the antennae, sinuate between the eyes, posterior ocelli placed between the submiddle part of the eyes; antennae inserted barely anterior to the eyes. Pronotum rugose-scabrous, anteriorly angulate, produced over the head; dorsum elevated tumid forward, longitudinally arcuate, profoundly impressed behind the disc, process nodulose-tuberculose, posteriorly abbreviated, the apex obtuse emarginate; median carina in the forward half entire, arcuate, but posteriorly sinuate becoming obsolete toward the apex; superior lateral carinae wanting, posterior angles of lateral lobes obliquely excised. Elytra and wings wanting. Anterior and middle femora little compressed, the inferior margin of anterior femora lightly unilobate; the middle femora above undulate, below trilobate, the middle lobe more distinct; posterior femora incrassate, the external area scabrous, superior margins granulate and subdentate before the knee, the praegenicular and genicular lobes moderately acute; hind tibiae somewhat incrassate, little ampliate toward the apices, armed with acute spines; first articles of posterior tarsi nearly twice the length of the third, the first and second pulvilli acute, the third flat below and nearly equal in length to the first and second combined.

Entire length of body, female, 8.8 mm.; pronotum 7.5 mm.; posterior femora 5 mm.

Two female examples from Cape Town, Africa, 100 ft., Rondebosch, August 17, 1905, collected and presented by Mr. Guy Marshall to the University Museum, Oxford.

2. *T. conofrons*, sp. nov.

Stature small, granulate, or little rugose. Resembling *Tettix latipes*, Stål, but having the vertex strongly advanced beyond the eyes, the facial costa barely sinuate between the eyes, head in profile conical, the apex little elevated anteriorly. Pronotum anteriorly obtuse angulate produced, more obtuse in the female, posteriorly not extended to the knees of hind femora, the apex somewhat narrowly obtuse emarginate; dorsum in female transversely subtumid between the shoulders, or little compresso-rectiform in the male, not impressed behind the disc; median carina longitudinally convexly arcuate, posteriorly disappearing near the apex; humeral angles somewhat obscure, nearly straight; posterior angles of lateral lobes little obliquely excised. Elytra and wings wanting. Anterior and middle femora little compressed, the inferior margins of anterior femora subundulate, of middle triundulate; the first and second pulvilli

of first tarsal articles small, acute, the third longer than the second, and flat below.

Entire length of body, male and female, 6·5–7·5 mm.; pronotum 4·7–5·5 mm.; posterior femora 3·5–4·5 mm.

Two examples, Nos. 11051 and 11060, from Cape Town, 100 ft., Rondebosch, August 17, 1905, collected and presented by Mr. Guy Marshall to the University Museum, Oxford.

Genus *COPTOTETTIX*, Bolivar.

1. *C. planus*, Bolivar, Ann. Soc. Ent. Belg. xxxi, p. 289, 1887.

One female example from Port Essington, Australia, in the University Museum, Oxford.

2. *C. parvulus*, sp. nov.

A small form with undeveloped wings and abbreviated pronotum; allied to *rufipes*, Bolivar. Body dark gray variegated with fuscous; vertex rather wider than one of the eyes, flattened, fossulate on each side forward; frontal costa little produced beyond the eyes, barely sinuate, narrowly compressed; antennæ inserted between the lower part of the eyes. Pronotum somewhat depressed, rugose, between the shoulders bearing abbreviated carinulæ; humeral angles widely obtuse, nearly straight, process extended backward nearly to the knees of hind femora; lateral carinæ not percurrent forward on the shoulders; median carina undulate, interrupted; posterior angles of the lateral lobes narrowly excised, superior sinus very shallow, the inferior deeply angularly excavate. Elytra oval; wings abbreviated. Anterior and middle femora little compressed, subentire; posterior femora elongate, the prægenicular lobes moderately acute produced, three pulvilli of first tarsal articles acute, and subequal in length.

Entire length of body, male, 7·5 mm.; pronotum 6 mm.; posterior femora 4 mm.

One example, No. 10944, from Zambesi, 3000 ft., Victoria Falls, Africa, "Rain forest," September 13, 1905; collected and presented by Professor Hudson Beare to the University Museum, Oxford.

3. *C. tuberculatus*, Bol., Ann. Soc. Ent. Belg. xxxi, p. 291, 1887.

Two female examples, Nos. 7264–7265, from Borneo; A. de Bormans' collection, labelled "*Tettix similis* Krauss."

Genus *HEDOTETTIX*, Bolivar.

1. *H. gracilis*, Haan, Bijdrag. Orthopt. p. 169, 1845.

Two female and three male examples from Madras, India; University Museum, Oxford.

- 2a. *H. gracilis abortus*, Hancock, Spolia Zeylanica, ii, p. 151, 1904.

Two female examples of this short-wing form from the same locality as preceding (Madras, India); University Museum, Oxford.

3. *H. punctatus*, sp. nov.

A very distinct species, with unknown habitat, resembling *gracilis*, Haan, but having the anterior femora little compressed, the pronotum strongly compresso-cristate, the front margin very distinctly angulate produced over the head, the median carina forward strongly arcuately elevated between the shoulders, very thin and the punctulations translucent when held against the light; the vertex subnarrower than one of the eyes, the front margin obtuse angulate, middle carinate, in profile obtuse but not distinctly rounded, the frontal costa somewhat narrowly sulcate, compressed, the rami subparallel; the wings caudate.

Entire length of body, female, 14.5 mm.; pronotum 11 mm.; posterior femora 5.8 mm.

One example, locality unknown; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

4. *H. affinis*, Bol., Ann. Soc. Ent. Belg. xxxi, p. 285, 1887.

One female example referable to this species from Port Essington, Australia.

5. *H. angustatus*, sp. nov.

A very slender form occupying the border line between *Hedotettix* and *Paratettix*. Body granulate, head very little exerted; antennae inserted between the lower part of the eyes, articles elongate; eyes little elevated; vertex narrower than one of the eyes, scarcely at all narrowed, or ampliate forward, longitudinally fossulate, in profile advanced beyond the eyes; frontal costa narrowly sulcate, in profile not at all sinuate, convex between the antennae. Pronotum anteriorly truncate, very narrow between the shoulders; median carina

percurrent, entire, but little elevated, scarcely convex forward and nearly straight on the lengthened posterior process; lateral carinæ distinct; process lengthily extended beyond the apices of posterior femora. Anterior and middle femoral margins entire; posterior femora narrow elongate. Elytra oval; wings caudate, the first and third articles of the posterior tarsi nearly equal in length, the first and second pulvilli acute, the third flat below and longer than the second.

Entire length of body, male and female, 12-13.5 mm.; pronotum 7.8-9.5 mm.; posterior femora 4 mm.

One male and one female from Sarawak, Borneo, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Two male examples from Banguay, Borneo (Staudinger coll.), in the author's collection.

Genus MICRONOTUS, Hancock.

1. *M. caudatus* (Sauss.), Orthopt. nova Amer. in Rev. et Mag. de Zool. p. 30, 1861.

= *Tettix caudatus*, Saussure, = *Paratettix caudatus*, Bolivar.

This species is common in South America and the West Indies. It is subject to considerable variation especially in the female, with respect to the undulation of the median carina of pronotum; just behind the anterior margin it is often cristulate, then taking an undulating course backward, it varies in the size and number of undulations. Represented by nine examples in the University Museum, Oxford, as follows: Three males and one female from Rio de Janeiro (probably), presented by J. W. Miers; one female from Rio Grande do Sul, No. 9256, presented by Malcolm Burr and identified by Brunner v. Wattenwyl; two examples from Island of St. Vincent, West Indies; one example from Brazil (D. Swainson's coll.); one female from Trinidad, West Indies, from W. W. Saunders' coll., presented by Mrs. F. W. Hope.

2. *M. dubius*, sp. nov.

Resembling *hancocki*, Bruner. Body very small, having the frontal costa very slightly sinuate between the eyes; the median carina of pronotum irregularly and minutely sinuate; the dorsum somewhat scabrous, the inferior margin of the middle femora

minutely bilobate. The type presents a light marking covering the disc of the pronotum.

Entire length of body, female, 6 mm.; pronotum 5 mm.; posterior femora 3.3 mm.

One example, from "America Æquatorialis," in the University Museum, Oxford.

Genus APOTETTIX, Hancock.

1. *A. proximus*, Hanc., Trans. Ent. Soc. London, p. 237-238, 1907.

These examples have long wings, the body rufescent, the posterior femora striate longitudinally below with fuscous, the tibiae black, but pale annulate. The pronotal process extends backward beyond the hind femoral apices. This form differs from the short-wing type form, and may bear the distinctive name, *A. proximus appositus*, form nov.

Entire length of body, male, 12 mm.; pronotum 10 mm.; posterior femora 5 mm.

Two male examples from Cachabi, Ecuador, collected by Rosenberg; presented by Malcolm Burr to the University Museum, Oxford.

Section BATRACHIDEÆ, Bolivar.

Genus HALMATETTIX, nov.

Resembling *Batrachidea*, Serville, but differing in having the pronotum compresso-cristate, in the absence of the posterior elytral sinuses, in the apterous body, and in the unarmed femoral apices. Body granulate; face slightly oblique, crown covered by the pronotum; vertex wider than one of the eyes, truncate anteriorly, bearing small carinulate lobes on each side next to the eyes, and distinct supraocular lobes behind; median carina wanting, frontal costa moderately sulcate, the rami slightly incrassate, in profile distinctly advanced beyond the eyes, the facial carina above moderately compressed; antennæ inserted barely below the inferior margin of the eyes; eyes sub-conoidal in profile, of moderate size, but somewhat prominent; maxillary palpi having the apical articles strongly dilated and pale coloured. Pronotum tectiform, the dorsum compresso-cristate, arcuate forward, posterior process not reaching to abdominal apex, the anterior margin strongly acuminate, produced over the head and strongly uncinate; median carina compressed, thin and entire; prozonal carinæ slightly evident, subparallel,

humeral angles substraight, lateral lobes posteriorly without elytral or inferior sinuses. Elytra and wings wanting; anterior and middle femora slender, margins entire, the superior carinæ not at all spined at the apices.

The type is *Halmatattix cristinotus*, herewith described:

1. *H. cristinotus*, sp. nov. (Plate XXII, fig. 8.)

Body somewhat incrassate, conspersed with light granulations, coloured ferruginous variegated with fuscous, the lateral margins and underneath black; vertex little wider than one of the eyes. Pronotum having the acute apex in front advanced barely beyond the frontal costa, the posterior process obtuse, acuminate toward the apex; lateral margins bicarinate; median carina thinly compressed; elevated, punctate translucent when held against the light.

Entire length of body, female, 14·5 mm.; pronotum 13 mm. (posterior femora mutilated).

One example from Rio de Janeiro (probably), Brazil, collected and presented by J. W. Miers to the University Museum, Oxford.

Genus SCARIA, Bolivar.

1. *S. ferruginea*, sp. nov.

Body moderately crassate, ferruginous, not at all fasciated with fuscous on sides or striate above; head little compresso-elevated, the base of eyes lower than the summit of middle of dorsum; vertex slightly tumid, somewhat smooth granulate, roundly deflexed in front, bearing indistinct small oblique carinulate lobes on each side next to the eyes; frontal costa rounded, little protuberant between the antennæ, narrowly sulcate; eyes large and globose. Pronotum anteriorly produced in a rather valid uncinate spine, the base little oblique; median carina percurrent, nearly horizontal, somewhat compressed and incrassate forward, little ascendant near and toward the front, but posteriorly toward the apex of process indistinct; lateral carinæ percurrent forward on the shoulders and distinctly expressed, process extended beyond the posterior femoral apices. Elytra having each of the bases ferruginous but posteriorly black and bearing a distinct pale præapical macula; wings fully explicate extended beyond the apex of pronotal process. Middle femora armed with an apical spine; anterior femora not armed at the apices; posterior femora having the inferior part fuscous but obscured by a covering of pale granulations; inside of hind femora

infusate, hind tibiæ ferruginous, obscurely infusate at the middle part. The subgenital plate of the female abdomen having the apical marginal sinus broadly and yet quadrately excavate, equal in width to the bases of both inferior blades of ovipositor, the small angulate lobe thus formed on each side smooth, underneath the subgenital plate is infusate.

Entire length of body, female (front to end of wings), 15 mm.; pronotum 12·8 mm.; posterior femora 7·5 mm.

One example from Brazil, S. America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

2. *S. brevis*, sp. nov.

Male.—Colour: dorsum of pronotum, vertex, and the anterior and middle legs brownish ferruginous, face below the eyes and lateral lobes below the middle pale yellow; lateral lobes above obscurely infuscated or pale granulate; the elytra, posterior femora, and hind tibiæ dark infusate; abdomen pale yellow toward the apex. Body small, pronotum and wings abbreviated, elytra immaculate; head little compresso-elevated, the base of the large globose eyes much lower than the middle dorsal summit; vertex smooth, sides convergent forward, nearly equal in width to one of the eyes, viewed from above the frontal costa barely protrudes beyond the anterior border; frontal costa narrowly compressed between the antennæ, in profile convex, the face oblique. Pronotum very small, anteriorly produced in an elevated uncinat spine, posterior process acute not at all extended backward to the knees of hind femora; median carina percurrent, little obliquely ascendant forward, and horizontal posteriorly; prozonal carinæ subexpressed; lateral carinæ distinct at the humeral angles, anterior and middle femoral apices not at all spined.

Entire length of body from front to apices of hind femora, 9·7 mm.; pronotum 7·5 mm.; posterior femora 5·5 mm.

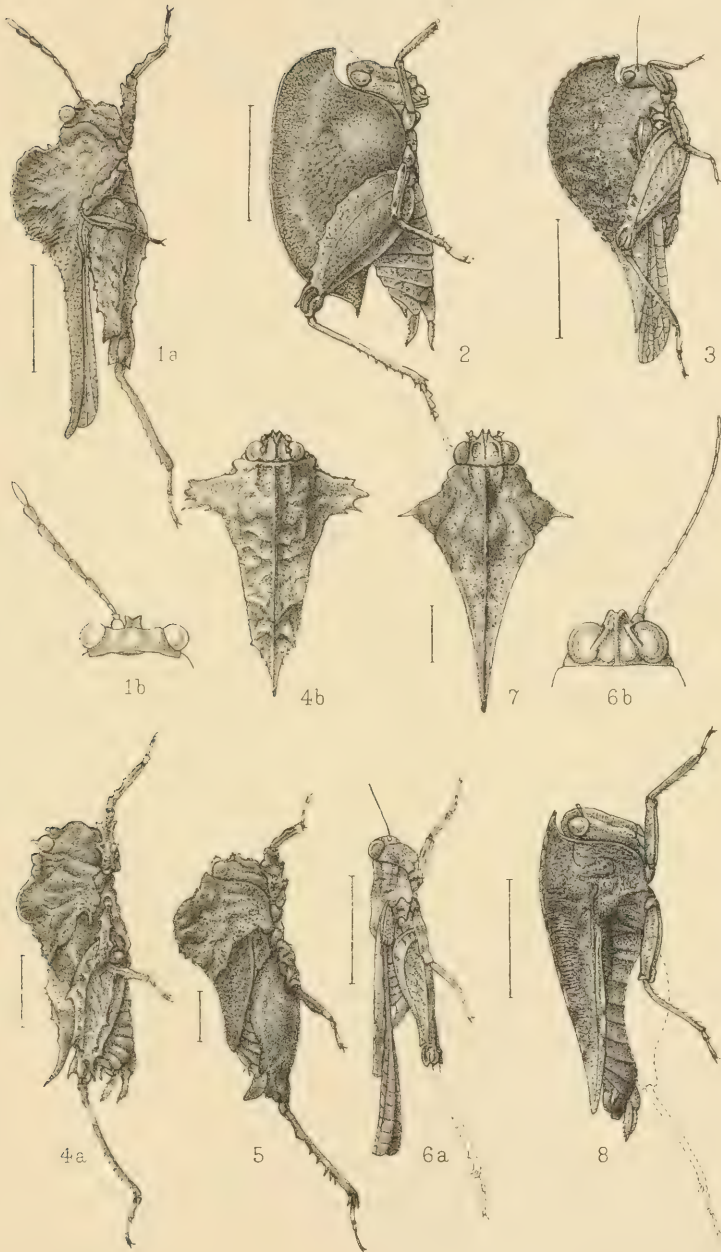
One example from Cachabi, Ecuador, 500 ft., Nov. 1906, collected by Rosenberg; presented by Malcolm Burr to the University Museum, Oxford.

EXPLANATION OF PLATE XXII.

[See *Explanation facing the PLATE.*]

EXPLANATION OF PLATE XXII.

- FIG. 1. *Lophotettix brevicristatus*, gen. et sp. nov.
(a) Side view of body; (b) one of the antennæ and head viewed from above.
2. *Holoarcus altinotus*, gen. et sp. nov.
Side view of body.
3. *Oxyphyllum pennatum*, gen. et sp. nov.
Side view of body.
4. *Tettilobus spinifrons*, gen. et sp. nov.
(a) Side view of body; (b) dorsal view showing the lateral lobe of pronotum with the posterior angle.
5. *Gignotettix burri*, gen. et sp. nov.
Side view of body.
6. *Orthotettix obliquifrons*, gen. et sp. nov.
(a) Side view of body; (b) head showing vertex viewed from above.
7. *Thoradonta spinata*, gen. et sp. nov.
Viewed from above, showing head and lateral lobes of pronotum.
8. *Halmatettix cristinotus*, gen. et sp. nov.
Side view of body (hind femora missing in type).



H. Knight del. et lith.

West, Newman imp.

NEW SPECIES OF TETRIGINÆ.

DOTT. ACHILLE GRIFFINI

STUDI
SUI GRILLACRIDI DEL MUSEO DI OXFORD

PARTE I^A

Specie etiopiche, indo-malesi ed australiane



PAVIA

PREMIATA TIPOGRAFIA SUCCESSORI FRATELLI FUSI

Largo di Via Roma, N. 7

1909

STUDI SUI GRILLACRIDI DEL MUSEO DI OXFORD

pel socio

Dott. Achille Griffini

PARTE I^a

Specie etiopiche, indo-malesi ed australiane

Il prof. R. SHELFORD, del Museo Zoologico Universitario di Oxford (Gran Bretagna) volle cortesemente inviarmi i Grillacridi indeterminati appartenenti alle collezioni di quel Museo, affidandomene la classificazione.

Della sua gentilezza e delle lusinghiere parole colle quali egli a me si è rivolto, lo ringrazio ancor qui sentitamente.

Gli esemplari comunicatimi sono tutti preparati a secco; alcuni, probabilmente molto vecchi, sono ancora trapassati da grossi e brevi spilli, ed in parte sono un po' guasti; quelli più recentemente avuti, e principalmente quelli donati al Museo dallo stesso prof. Shelford, dal D^r. M. Burr e da qualche altro raccoglitore, sono in molto migliori condizioni. Le specie mi risultano essere numerose, in parte rare o poco note, ed in parte anche nuove.

Nella presente memoria pubblico il risultato dei miei studi sopra le specie etiopiche (di Madagascar e di Mauritius) e sopra le numerose interessanti specie indo-malesi ed australiane contenute nelle collezioni del Museo di Oxford statemi inviate: mi riservo di descrivere in una seconda parte le specie americane.

Genova, R. Istituto Tecnico, 25 Gennaio 1909.

Gryllacris borneensis subsp. ***Frühstorferi*** Griffini.

♀. — *Gryllacris borneensis* subsp. *Frühstorferi* Griffini 1908
(8) pag. 13-14.

1 ♀. — Singapore, Botany Gardens.

Questa ♀ è piuttosto grande, e corrisponde però ottimamente alla descrizione da me data dal tipo di questa sottospecie, appartenente al K. Zoolog. Museum di Berlino:

<i>Longitudo corporis</i>	mm. 35,5 (abdomine extenso)
" <i>pronoti</i>	" 7,3
" <i>elytrorum</i>	" 52
" <i>femorum anticorum</i>	" 12,3
" <i>femorum posticorum</i>	" 23
" <i>ovipositoris</i>	" 24,2

Caput ut in typo, totum saturate ferrugineum; maculae ocellares parum perspicuae; palpi etiam saturate ferruginei, articulis basi fuscioribus, apice pallidioribus. Pronotum disco latiuscule ferrugineo, sulcis bene expressis.

Elytra, pleurae, pedes, segmenta ventralia, ut in typo quem descripsi. Femora postica tamen subtus margine externo 8-9 spinuloso, margine interno usque ad 14 spinuloso.

Ovipositor subtotus ater, basi pernitidus, dein minute punctulatus, denique ad apicem crebre ruguloso-scabriusculus.

***Gryllacris baramica* Kirby.**

♂. — *Gryllacris fasciata* Brunner 1898 (4), pag. 275 (nec Walker).

Gryllacris baramica Kirby 1906 (11), pag. 140.

1 ♂. — N. W. Borneo; N. Sarawak, Trusan. Coll. June 03.
Pres. 1906 by the Sarawak Museum.

È perfettamente intermedio fra la *Gr. nigrata*. Brunn. e la *Gr. fasciata* Walker nec Brunner da me ridescritta (8, pag. 2-4). Anzi è forse più vicino a quest'ultima.

<i>Longitudo corporis</i>	mm. 19,4
" <i>pronoti</i>	" 5,6
" <i>elytrorum</i>	" 16,5
" <i>femorum anticorum</i>	" 7,4
" <i>femorum posticorum</i>	" 12,5
" <i>segmenti octavi abdominis</i>	" 3

Fastigium verticis articuli primi antennarum latitudinem 1 $\frac{1}{2}$, attingens et subsuperans, eius latitudinem duplam haud attingens. Antennae totae pallidae. Oculi fere globosi (perparum elongati). Occiput fusco-testaceum; vertex niger, fastigio testaceo maculato basi anterieus (inferius) utrinque fusca; fastigium

frontis macula saturate testacea maiuscula praeditum; frons nigra, perparum testaceo maculata, neque reticulata ut in typo Brunneri. Genae, clypeus, labrum, luteo-testacea; palpi pallidi.

Pronotum convexum, ut in *Gr. fasciata* Walk. a me descripta confectum sed circiter ut in *Gr. nigrata* coloratum; atrum, macula antica lutea cum medio marginis antici contigua, in sulco antico constricta, postice latiore, maculis 2 luteis (antica et postica) in utroque lobo laterali, vitta transversa obscure lutea indecisa ad marginem posticum in metazona antierius in medium dorsi sensim extensa.

Elytra apicem abdominis attingentia, alis sensim breviora, ut in descriptione Brunneri picta.

Pedes ut in descriptione Brunneri picti, annulis tamen antepicalibus tibiaram omnium valde dilutis. Spinae tibiaram 4 anticarum modicae. Femora postica basi valde incrassata, apice fere gracilia, subtus spinulis nigris utrinque 14-17 praedita. Tibiae posticae superne parum planiusculae, spinis extus 7, intus 6, basi brunneis ibique dilute brunneo circumdatis, dein pallidis, apice rursus leviter fuscis.

Apex abdominis ♂ valde pubescens, ut in *Gr. fasciata* Walk. a me descripta supra subtusque confectus.

***Gryllacris aequalis* (Walker).**

♂. — *Acheta aequalis* Walker 1859 (15), pag. 222.

♂, ♀. — *Gryllacris annulata* Brunner 1888 (2), pag. 333-34, Tab. VIII, fig. 41 A. — Morton 1908 (13), pag. 201 (*annulatus*).

Gryllacris aequalis Kirby 1906 (11), pag. 141.

1 ♂. — Bengal.

1 ♀. — Pundaloya, Ceylon — M. Burr Collection. Pres. 1903 by M. B.

	♂	♀	
<i>Lunghezza del corpo</i>	mm. 23,5	26	(abdomine extenso)
" <i>del pronoto</i>	" 4,8	5	
" <i>delle elitre</i>	" 31	31,8	
" <i>dei femori anteriori</i>	" 7,3	7,3	
" <i>dei femori posteriori</i>	" 13,4	13,5	
" <i>dell'ovopositore</i>	" —	19,5	

Il ♂ è piuttosto pallido, fors'anche in parte scolorito dal tempo; la ♀ invece ha le tinte oscure molto accentuate.

Il capo della ♀ presenta l'occipite e il vertice in gran parte neri, due indecise striscie oscure ai lati della sommità della fronte, e due larghe fascie nere suboculari, poco bene delimitate. Questi disegni nel ♂ sono quasi nulli, essendo in esso solo nerastri i lati del vertice del capo sopra gli occhi, dietro le antenne. Le antenne della ♀ hanno il primo articolo pallido, alcuni pochi seguenti bruni, gli altri nuovamente pallidi.

Il pronoto del ♂ presenta il caratteristico disegno descritto da Walker, cioè una fascia posteriore trasversale nerastra arcuata, appuntita anteriormente da ambo i lati, lievemente interrotta al mezzo, e che da questa sua parte mediana protende innanzi lungo il mezzo del dorso due fascie alquanto sinuose che presso il solco anteriore presentano un ingrossamento, apparendo così quivi riaccostarsi: il loro colore oscuro si estende un pò anche nel solco anteriore, esternamente. Questi disegni esistono anche nella ♀, ma talmente più sviluppati e fusi, da apparire il dorso del pronoto ampiamente nero, eccettuato il margine anteriore e più sottilmente il margine posteriore nettamente pallidi: il colore nero si continua largamente nei rami dei solchi V-formi dei lobi laterali, mentre poi dall'interno di questi risalgono superiormente nel dorso due irregolari fascie oblique giallastre; il margine dei lobi laterali è largamente giallastro.

Il grande sviluppo del colore nero sul pronoto e qualche altro carattere fanno pertanto somigliare questa ♀, a prima vista, ad una *Gr. tibialis*.

Le larghe anellature nere delle tibie non sono veramente al mezzo come scrive Brunner, ma alquanto più presso alla base che non all'apice; nel ♂, scolorito, quelle delle 4 zampe anteriori sono poco visibili. Le tibie posteriori sono poco depresse superiormente, e ciò solo a notevole distanza dalla base; presentano 5-6 spine oscure su ciascun margine, di cui quelle al di là della fascia nera hanno la base pallida. Notevoli e caratteristici sono gli spigoli inferiori dei femori posteriori sottilmente nerastri; questi presentano 5-7 spine oscure su ciascun margine.

Elitre ed ali vitree: le vene e venule delle elitre nella ♀ sono tutte nerastre, il che ben la distingue dalla *Gr. tibialis* in cui le vene del campo mediano sono giallo-rossiccie; la parte anteriore delle ali è egualmente a vene nerastre, la parte

posteriore ha venature brunicce. Le elitre del ♂, scolorate, hanno le venature appena brune.

Gli organi all'apice dell'addome corrispondono alla descrizione di Brunner.

Aggiungerò qualche carattere del pronoto:

Pronotum optime limbatum, margine antico parum rotundato, margine postico subrecto; sulco antico bene impresso, sulculo longitudinali abbreviato latiusculo et sat impresso, sulco postico valliforme perparum profundo; metazona levissime ascendens. Lobi laterales subrectangulares sed postice quam antice altiores, margine infero subsinuato, angulo postico truncato, margine postico verticali modico, sinu humerali distincto. Sulcus V-formis et sulcus posticus loborum lateralium sat bene impressi.

Gryllacris frontalis (Burm.) Kirby.

Gryllacris frontalis Burmeister 1838 (5); pag. 718, teste Kirby 1906 (11), pag. 142.

♂. — *Gryllacris scita* Walker 1869 (16), pag. 181-82.

♂. — *Gryllacris latifrons* Brunner 1888 (2), pag. 339. — ♀ Brunner 1893 (3), pag. 189-190.

1 ♂. — India.

1 ♂, senza indicazione di località.

Specie molto distinta e rimarchevole, che colla susseguente che le è somigliantissima merita di formare un gruppo particolare.

♂ <i>Longitudo corporis</i>	mm. 28 — 34,7
" <i>pronoti</i>	" 7 — 7,2
" <i>elytrorum</i>	" 35,5 — 39
" <i>femorum anticorum</i>	" 9,5 — 9,9
" <i>femorum posticorum</i>	" 15 — 16
" <i>segmenti octavi abdominis</i>	" 4,5 — 5,2

Caput maiusculum, orbiculare, pronoto latius. Fastigium verticis fusco-castaneum. Frons interdum cum genis et occipite tota testacea, interdum leviter infuscata ⁽¹⁾, brevis, lata, inferius supra clypeum grosse bi-foveata, minute rugulosa. Sulci suboculares explicati. Clypeus et labrum flavida-ferruginea; mandi-

(1) Interdum nigra, secundum descriptiones Walkeri et Burmeisteri.

bulae nigrae basi extus argute bicarinatae; palpi et antennae pallida. Macula ocellaris frontalis ovato rotundata, magna. Fastigium verticis articuli primi antennarum latitudinem duplam attingens vel minime superans, lateribus carinatis.

Pronotum margine antico minime producto; sulco antico valliforme, lato, minime impresso; sulculo longitudinali abbreviato posteriorius latiusculo; margine postico truncato et ut in descriptione Walkeri dilute transverse infuscato. Sulcus anticus etiam dilutissime in medio fuscus. Lobi laterales humiles, multo longiores quam altiores, antice fere magis alti quam postice, margine infero ante coxas anticas levissime sinuato, angulo antico rotundato-truncato, angulo postico rotundato obtusissimo, margine postico subtoto obliquo, sinu humerali perparvo. Pars antica lorum lateralium minus adpressa propter magnam latitudinem capitis. Sulci V-formes lati, sat impressi.

Elytra et alae ut in descriptionibus Brunneri et Walkeri.

Pedes robustiusculi. Tibiae 4 anticae spinis haud multo longis. Femora postica breviuscula, incrassata, parte apicali attenuata brevi, spinis in utroque margine circiter 5, parvis, nigris, basi pallidis. Tibiae posticae post basim planatae, spinis sat parvis 5-6 nigris vel fuscis, basi pallidis, utrinque praeditae. Tarsi maiusculi.

Apex abdominis ut in descriptione Brunneri.

Il prof. Shelford mi scrive che il tipo della *Gr. scita* Walk. si trova al Museo di Oxford. La sinonimia, già stabilita da Kirby, è da lui confermata.

***Gryllacris simplex* Walker.**

♂. — *Gryllacris simplex* Walker 1871 (17), pag. 20. — Kirby 1906 (11), pag. 142.

♂, ♀. — *Gryllacris hieroglyphica* Brunner 1888 (2), pag. 338-39.

1 ♂. — India orientalis.

È estremamente somigliante alla specie precedente, e lo riferisco alla *Gr. simplex* piuttosto che non alla *frontalis* pei disegni del pronoto (invero appena diffusamente accennati), per la statura leggermente maggiore, e per le elitre più lunghe. Gli altri caratteri mi pare coincidano anche nelle descrizioni delle due specie, che forse non sono che sottospecie di una sola.

Il capo nell'esemplare in discorso ha la sommità del vertice pallida come tutto il resto del vertice, dell'occipite, delle guancie e della fronte; già però vedemmo nella specie antecedente come la fronte possa variare dal pallido al bruno fino al nero; potrà pur variare la tinta della sommità del vertice.

<i>Longitudo corporis</i>	mm. 30	(abdomine contracto)
" <i>pronoti</i>	" 7,2	
" <i>elytrorum</i>	" 43	
" <i>femorum anticorum</i>	" 11	
" <i>femorum posticorum</i>	" 17,2	
" <i>segmenti octavi abdominis</i>	" 4,5	

Pallide testacea. Caput ut in specie praecedente confectum, fronte eodem modo inferius grosse bi-foveata, minus rugulosa: fastigium verticis eodem modo confectum, cum reliquo capite concolor. Mandibulae piceae et ut in *Gr. frontali* extus argute bicarinatae. Macula ocellaris frontalis propter colorem pallidum capitis parum distincta.

Pronotum ut in specie praecedente, sed picturis a Brunner descriptis praeditum, colore tamen dilutissime brunneis. Lobi laterales ut in illa specie confecti, margine postico verticali melius (quamvis semper brevissimo) distincto. Elytra ut in *Gr. frontali*; sensim longiora.

Pedes ut in illa specie, tibiis tamen omnibus parum post basim fusco annulatis, et tibiis posticis in medio annulo dilute fusco (a Walker descripto) etiam praeditis.

Apex abdominis ut in *Gr. frontali*.

***Gryllacris Dyak* n. sp.**

♀. — *Apud Gryllacridem lineolatam* Serv. locanda, a qua differt pluribus notis, praecipue statura sensim maiore, pictura capitis, pedibus longitudinaliter atro vittatis, venulis alarum series minus numerosas efficientibus, valde latius fusco marginatis, ovipositore valde brevior, magis falcato, apice minus oblique truncato.

Statura modica. Ferruginea, facie saturatius rufo-ferruginea, clypeo basi fusco, apice flavido, labro cum mandibulis atro; maculis ocellaribus distinctis, flavis, verticis linearibus, frontali magna, scutiformi, acute circumscripta; pronoto concolore, incerte

nebuloso; pedibus longiusculis, femoribus subtus in utroque latere atro vittatis, femoribus posticis etiam extus villa atra longitudinali in parte dilatata ornatis; pleuris atratis; elytris ferrugineo tinctis, venulis anguste fusco circumdatis; alis subhyalinis, venulis fuscis et late fusco circumdatis; ovipositore femoris postici dimidiam longitudinem parum superante.

<i>Longitudo corporis</i>	mm. 28,4 — 31,5
" <i>pronoti</i>	" 6,5 — 6,8
" <i>elytrorum</i>	" 28,4 — 29,2
" <i>femorum anticorum</i>	" 11,3 — 11,5
" <i>femorum posticorum</i>	" 21,4 — 22,7
" <i>ovipositoris</i>	" 12,3 — 12,5

Habitat: N. W. Borneo. Kuching.

Typi: 2 ♀ (Musaei Universitatis in Oxford). Pres. 1900 by R. Shelford. Quarum prima: « Capt. Iun. 30-00 by Dyak coll. »; secunda: « Capt. Iuly 23-00 by Dyak coll. ».

Corpus robustiusculum, colore maxima parte ferrugineo.

Caput ab antico visum ovoideum. Occiput et vertex modice convexa. Fastigium verticis latitudinem primi articuli antenarum (crassiusculi) tantum vel aegre attingens, in medio depressiusculum, lateribus crassiuscule carinulatis. Frons sub lente sparse punctulata, inferius minute transverse rugulosa, ibique in medio impressa. Sulci suboculares adsunt. Organa buccalia solito modo confecta, longiuscula.

Occiput, vertex et genae ferrugineae. Fastigium verticis anterius et frons saturatius rufo-ferruginea, nitida; maculae ocellares flavae vel flavido-eburneae, bene delineatae; maculae verticis longiusculae, lineares, macula frontalis maiuscula, scutiformis, subtotum fastigium frontis superne replens, inferius subacuta, superne late subrotundata. Antennae ferrugineae, primis articulis etiam concoloribus, longe post basim articulis quibusdam incerte dilute fusco annulatis, annulo primo, dilutissimo, circiter ad articulum 18, secundo melius distincto ad articulum 27. Puncti duo nigri vel nigricantes sub insertione primi articuli utriusque antennae adsunt, internus superior, externus inferior. Clypeus basi irregulariter infuscatus vel partim atratus, apice irregulariter flavescens, praecipue in medio. Labrum cum mandibulis atrum. Palpi longi, ferruginei.

Pronotum a supero visum subquadratum, pubescens, minime nitidum, margine antico in medio rotundatim perparum producto, sulco antico bene impresso, sulculo longitudinali longiusculo, sulco postico subnullo, margine postico rotundato-subtruncato, metazona utrinque gibbulosa. Lobi laterales parum adpressi, modice humiles, postice altiores, margine infero circiter in medio subsinuato, angulo antico late rotundato, postico truncato, margine postico verticali breviusculo, sinu humerali fere nullo; sulcus V-formis et sulcus posticus bene impressi; intervalli gibbulosi.

Color pronoti ut reliqui corporis ferrugineus, incerte dilute nebulosus, forsan utrinque ad latera sulculi longitudinalis, praecipue antice, leviter fuscus, et utrinque ante metazonam transverse breviter pallidior.

Elytra modica, apicem femorum posticorum tantum vel aegre attingentia, alis distincte breviora, ferrugineo tincta, venis saturatius ferrugineis, venulis subtotis anguste sed distincte fusco marginatis, fasciis haud perfecte definitis. Alae subcycloideae, subhyalinae, leviter testaceo tinctae, venulis omnibus fuscis, late fusco circumdatis, vittis fuscis sat definitis, valde irregularibus, numero circiter 6-7 (dum in *lineolata* vittae regulares, subtiliores, numero 9-12).

Pedes longiusculi. Tibiae anticae solito modo spinosae, spinis valde longis, sed longitudine apicem versus decrescentibus. Femora postica basi sat incrassata, dimidio apicali sat longe attenuata, subtus utroque margine circiter 10-spinuloso, spinulis sat longis, acutis, fuscis, basi ferrugineis. Tibiae posticae supra post basim planiusculae, spinis extus 7, intus 6 apice fuscis, praeditae, necnon spinis apicalibus solitis.

Color pedum ferrugineus. Margines inferi femorum omnium subtiliuscule sed definite longitudinaliter atro vittati, vittis ad extremitates evanescentibus; interdum margines anteriores tantum hoc modo distincte sunt vittati, posteriores indistincte. Femora postica, insuper, extus in medio partis basalis dilatatae longitudinaliter etiam sunt atro vittata, vitta utrinque evanescente. Pleurae atratae.

Segmenta abdominalia dorsalia in medio infuscata. Ovipositor ferrugineus, inferius et apice saturatius, rigidus, nitidus, falcatus incurvus, breviusculus; sulco laterali longitudinali utrinque superne posito, latiusculo, sat longe ante basim et

ante apicem terminato. Apex ovipositoris haud distincte oblique truncatus, sed leviter glandiforme subdilatus, dein attenuatus, vertice subacuto. Lamina subgenitalis ♀ subtriangularis, apice sat acuto, in medio angulariter breviter inciso, lateribus crassiusculis, disco subexcavato.

***Gryllacris pardalina* Gerst.**

Gryllacris pardalina Gerstaecker 1860 (7), pag. 252-53. — Brunner 1888 (2), pag. 343-44. — Kirby 1906 (11), pag. 143.

Un ♂. — Pundaloya, Ceylon. M. Burr Collection. Pres. 1903 by M. B.

<i>Longitudo corporis</i>	mm. 35 (circiter)
" <i>pronoti</i>	" 6,9
" <i>elytrorum</i>	" 27,2
" <i>femorum anticorum</i>	" 10,2
" <i>femorum posticorum</i>	" 18
" <i>segmenti octavi abdominis</i>	" 9

Occiput et vertex maculas 4 nigras praebent, quarum 1 in medio occipitis, 2 laterales antierius versae, 1 in medio verticis.

Pronotum ut in descriptione Brunneri pictum, tamen margine postico haud fusco limbo, sed metazona in medio utrimque late fusca, inter partes fuscas et margine postico testacea. Margo anticus in medio rotundato parum productus, sulci bene expressi, metazona sensim ascendens; lobi laterales parum adpressi, longiores quam altiores, postice leviter altiores, margine infero minime sinuato, angulis solito modo confectis, margine postico verticali brevi, sinu humerali parum expresso; sulcus late U-formis valde impressus.

Mesonotum et metanotum magna parte superne nigrata.

Apex femorum omnium, basis tiliarum omnium, breviter sed distincte nigricantia; apex tiliarum breviter et tarsi dilute infuscati. Femora postica subtus in utroque margine 6-7 spinulosa, spinulis acutis apice fuscis. Tibiae posticae superne post basim planatae subsulcatae, spinulis extus 7, intus 6, omnibus longis, acutis, apice fuscis, necnon spinulis solitis apicalibus praeditae.

Segmenta abdominalia dorsalia ultima infuscata. Segmentum nonum ♂ obcordatum.

***Gryllacris ruficeps* Serville.**

Gryllacris ruficeps Serville et Auctorum. Griffini 1908 (9), pag. 7 (cum synonym.). — Griffini 1908 (10), p. 178.

1 ♂. — W. Java, about 600 ft., Buitenzorg. Capt. Apr. 7. 05 et pres. 1905 by R. Shelford.

Esemplare piuttosto robusto, le cui principali dimensioni sono le seguenti:

<i>Lunghezza del corpo</i>	mm. 29,5 (addome esteso)
" <i>del pronoto</i>	" 7,7
" <i>delle elitre</i>	" 34
" <i>dei femori anteriori</i>	" 10,4
" <i>dei femori posteriori</i>	" 16,2

Corrisponde bene alla specie tipica, abitante Giava, mentre gli esemplari di Malacca e di qualche isola vicina furono da me separati come sottospecie molto distinta (1908, 9, pag. 7-8).

***Gryllacris excelsa* Brunner.**

Gryllacris excelsa Brunner 1888 (2), pag. 351-52, Tab. VIII, fig. 41 D. — Kirby 1906 (11), pag. 144. — Griffini 1908 (9), pag. 8-9. — Griffini 1909. Le *Gryllacris* papuane ad ali bicolori, Bollett. Labor. Zoolog. Portici, vol. III, pag. 207 e 211.

2 ♀. — Cholmondeley Sale. — M. Burr collection. — Pres. 1903 by M. B.

Corrispondono bene alle descrizioni; hanno l'occipite, il vertice e gran parte della fronte fulvo-testacei.

La lunghezza dell'ovopositore arriva fino a mm. 28,5.

***Gryllacris nigrilabris* Gerst.**

Gryllacris nigrilabris Gerstaecker 1860 (7), pag. 262-63. — Brunner 1888 (2), pag. 354-55. — Kirby 1906 (11), pag. 145. — Griffini 1908 (10), pag. 179-80.

♀. — *Gryllacris fumosa* Walker 1869 (16), pag. 175.

A — 1 ♂. — North Borneo. Sandakan. Coll. about 1895-96 by A. L. Cook et pres. 1899 by Herbert Druce.

B — 1 ♂. — N. W. Borneo, Kuching. Coll. 30-XI-95. Pres. 1906 by the Sarawak Museum.

Questo secondo esemplare ha le ali completamente scolorite, forse per essere stato preparato colle ali aperte e da parecchi anni esposto in luce: e però le sue ali invece di essere intensamente brune sono appena lievemente brunicce, quasi vitree: le fascie nere circondanti le venule trasversali sono scomparse e non ne rimane che una impercettibile sfumatura; esiste invece ancora la macchietta pallida al centro di moltissime areole.

	A	B	
<i>Lunghezza del corpo</i>	mm. 37	30	(addome contratto)
" <i>del pronoto</i>	" 9	8,8	
" <i>delle elitre</i>	" 41	40	
" <i>dei femori anteriori</i>	" 13,7	13,7	
" <i>dei femori posteriori</i>	" 24	24	
" <i>dell'8° segmento addominale</i>	" 6	5,5	

Margo posticus pronoti truncatus, crasse limbatus. Sulci V-formes loborum lateralium optime impressi. Tarsi omnes maiusculi. Spinae tibiaram 4 anticarum longae. Femora postica subius margine externo spinis 8-9 sat validis, apicem versus maioribus, margine interno spinulis usque ad 14, quarum basilibus minutis armata; apex spinarum infuscatus. Tibiae posticae extus spinis 6-7, intus spinis 6 longiusculis armatae, superne planatae.

Elytra testacea, venis maioribus basi saturate ferrugineis. Alae intense brunneo tinctae, areolis permultis medio maculam parvam albidam includentibus: venulae nigricantes, nigro marginatae, fasciis haud bene delimitatis; area antica alarum venulis pallidis distincte brunneo marginatis.

La sinonimia della *Gr. fumosa* Walk. colla *nigrilabris* mi è indicata dal prof. Shelford; il tipo della *Gr. fumosa* si trova al Museo di Oxford, esso ha il labbro nero e Walker lo descrisse come avente il labbro pallido. L'opposto errore trovasi nella descrizione che Walker diede della *Gr. laeta*.

***Gryllacris fuscifrons* Gerst.**

♀. — *Gryllacris fuscifrons* Gerstaecker 1860 (7), pag. 255-56.

♂; ♀. — *Gryllacris fuscifrons* Brunner 1888 (2), pag. 350-51,

Tab. VIII, fig. 41 E. — Kirby 1906 (11), pag. 144.

1 ♂. — Iava.

Colgo l'occasione per far notare la variabilità nella venatura delle ali di questa specie frequente nelle collezioni. In alcuni individui le venule trasverse e quindi le fasce brune che le accompagnano sono meno numerose, formando ad esempio una serie di sole 6 fasce irregolari; in altri sono più numerose, come nell'esemplare del Museo di Oxford, formando una serie di fin 9 fasce irregolari. Le fasce stesse posson essere più o meno larghe; lo spazio basale non fasciato può essere più o meno sviluppato.

I femori posteriori hanno spesso inferiormente solo 8 spine per parte.

***Gryllacris fuscifrons* var. *pulchra* ...**

♂. — *A specie typica differt praecipue: pronoto superne subtoto nigro-piceo nitido, metazona tantum et parte postica loborum lateralium pallidis, alis venulis transversis nigro circumdatiis, fasciis nigris haud latioribus sed multo melius circumscriptis, necnon macula ocellari frontali maiuscula.*

<i>Longitudo corporis</i>	mm. 29
" <i>pronoti</i>	" 7,5
" <i>elytrorum</i>	" 33,4
" <i>femorum anticorum</i>	" 11,5
" <i>femorum posticorum</i>	" 20,4
" <i>segmenti octavi abdominis</i>	" 3,6

Habitat: W. Iava.

Typus: 1 ♂ (Musaei Universitatis in Oxford) indicationem sequentem gerens: W. Iava, about 2000 ft. Garoet. Capti. Apr. 12-05 et pres. 1905 by R. Shelford.

Corpus ut in *Gr. fuscifrons*, forma leviter elongatiore.

Caput ut in specie; saturatius ferrugineum, fastigio verticis et fastigio frontis infuscatis; maculae ocellares verticis angustae, elongatiusculae, basi et apice cum maculis incertis rufis contiguae; macula ocellaris frontalis maiuscula, bene delineata, subovata, superne a sutura inter fastigia capitis recte truncata. Articulus primus antennarum solus ater, secundus leviter fuscus. Caeterum, antennae, palpi et reliquum caput ut in specie.

Pronotum convexiusculum, longius quam latius, antice minime rotundatum, sulco antico bene impresso, sulculo longitu-

dinali abbreviato posterius fossulari, sulco postico apud marginem posticum sito parum impresso, margine postico truncato. Lobi laterales multo longiores quam altiores, postice altiores, sulcis valde impressis, sinu humerali fere admodum nullo.

Color pronoti maxima parte atro-piceus, nitidus, tantum metazona nitide ferruginea, hoc colore ibi circiter mm. 1,2 lato, in utroque lobo laterali posterius descendente, ibique inferius dilatato, marginem inferum tangente, a margine postico, margine infero et ramo postico sulcorum V-formium limitato; caeterum, lobi laterales cum margine antico (ut pars supera pronoti cum margine antico) atro-picei.

Elytra ut in specie. Alae ut in specie, sed venulis transversis fuscis nigro circumdatis, fasciis nigris melius circumscriptis, numerosis (circiter 9-10).

Pedes ut in specie. Femora postica ad apicem sat longe attenuata, subtus in utroque margine spinulis 8-10 nigris, basi pallidis, armata. Tibiae posticae supra post basim planatae, spinulis utrinque 6 apice nigro-fuscis. Tarsi maiusculi.

Genitalia ♂ ut in specie.

Gryllacris nobilis Walker.

♂. — *Gryllacris nobilis* Walker 1869 (16), pag. 182-83.

♂, ♀. — *Gryllacris lugubris* Brunner 1888 (2), pag. 353-54. — Kirby 1906 (11), pag. 145.

Due ♂. — Singapore, Botany Gardens.

Corrispondono abbastanza bene alla descrizione di Brunner. La fronte di uno di essi è alquanto bruna, e perciò questo esemplare si avvicinerrebbe alla *Gr. variabilis* Br., ma per tutti gli altri caratteri esso coincide assolutamente coll'altro.

<i>Longitudo corporis</i>	mm. 32,3 — 36,6
" <i>pronoti</i>	" 7,8 — 8
" <i>elytrorum</i>	" 36,5 — 37,7
" <i>femorum anticorum</i>	" 12 — 12,5
" <i>femorum posticorum</i>	" 20,8 — 21,5
" <i>segmenti octavi abdominis</i>	" 6

Saturate ferruginea, capite interdum antierius et in vertice fuscioro, pronoto incertissime fusco picto (praecipue in sulcis V-formibus et pictura supera circiter ut in *Gr. signifera* Stoll.).

Fastigium verticis latitudinem primi articuli antennarum parum superans, eius latitudinem $1\frac{1}{2}$, haud attingens. Maculae ocellares indistinctae vel diffuse delineatae, longiusculae. Organa buccalia et antennae cum reliquo capite concolora; primus articulus antennarum dum caput infuscatum eodem modo infuscatus. Frons sub lente punctulata, minute rugulosa, et inferius punctis 2 maioribus supra basim clypei praedita.

Pronotum margine antico minime prominulo, sulco antico bene impresso, sulculo longitudinali abbreviato posterius tantum expresso, ibique fossulari, sulco postico apud marginem posticum sito parum impresso, margine postico optime limbato, transverso. Metazona brevissima, leviter ascendens; pronotum ante eam utrinque gibbulosum. Lobi laterales multo longiores quam altiores, postice distincte altiores, margine infero minime sinuato, angulis solito modo confectis, margine postico verticali sat alto, sinu humerali distincto, sulcis bene impressis.

Elytra ut in descriptione Brunneri, leviter infumato-tessellata. Alae etiam ut in descriptione auctoris, infumatae, medio areolarum hyalino.

Pedes longiusculi, interdum partim fusco nebulosi. Tibiae anticae solito modo spinosae, spinis valde longis. Femora postica basi sat incrassata, apice sat longe attenuata, subtus in utroque margine usque ad 9-spinulosa, spinulis sat longis, acutis, robustis, apice fuscis. Tibiae posticae superne post basim planatae, extus spinulis 7, intus spinulis 6 armatae, spinulis longiusculis, apice fuscis. Tarsi maiusculi, leviter fusciores.

Segmentum abdominale dorsale nonum ♂ apice breviter inferius angustato productum, ibi leviter in medio sinuatum ibique utrinque obtuse dentatum; sub hac prominentia, inferne, basin versus, prominentia secunda admodum similis adest. Lamina subgenitalis transversa, anguste triangulariter emarginata.

Avevo determinata questa specie come *Gr. lugubris* Br. La sinonimia della *Gr. lugubris* colla *Gr. nobilis* Walk. mi è indicata dal prof. Shelford, possedendo il Museo di Oxford il tipo della *Gr. nobilis* Walk. Dal solo studio della infelice descrizione che Walker ha dato di questa specie tale sinonimia non avrebbe potuto essere indovinata; l'autore ad esempio parla di *ali cineree* senza darne altro carattere.

Gryllacris obscura* var. *sumatrana Griffini.

♂, ♀. — *Gryllacris obscura* var. *sumatrana* Griffini 1908 (8), pag. 9-10.

Una ♀. — Kwala Aring, Laidlaw, Malay peninsula. M. Burr collection. Pres. 1903 by M. B.

Esemplare molto robusto, alquanto più grosso di quelli di Sumatra, però ad essi ben corrispondente in ogni carattere. Ecco le principali dimensioni:

<i>Lunghezza del corpo</i>	mm. 35,5
" <i>del pronoto</i>	" 8,6
" <i>delle elitre</i>	" 37
" <i>dei femori anteriori</i>	" 12,5
" <i>dei femori posteriori</i>	" 23
" <i>dell'ovopositore</i>	" 25,3

Gryllacris malayana Fritze.

♂, ♀. — *Gryllacris malayana* Fritze in Carl 1908 (6), pag. 305, Tav. VII, fig. 11.

1 ♂. — N. W. Borneo, Kuching. — Cap. Iuly 20-00 by Dyak coll. — Pres. 1900 by R. Shelford.

Per molti caratteri corrisponde bene alla descrizione originale; per qualcuno se ne discosta alquanto.

<i>Longitudo corporis</i>	mm. 31
" <i>pronoti</i>	" 7
" <i>elytrorum</i>	" 32
" <i>femorum anticorum</i>	" 11,8
" <i>femorum posticorum</i>	" 20
" <i>segmenti octavi abdominis</i>	" 4,9

Testaceo-ferruginea, capite fere toto concolore, femoribus omnibus summo apice subtiliter et distincte nigro annulatis, tibiis omnibus parum post basim superne macula transversa atra ornatis.

Caput ab antico visum ovatum elongatum, fronte inferius et clypeo pallidioribus, labro ferrugineo-fusco. Occiput et vertex ferruginea. Maculae ocellares distinctae, verticis parvae, frontalis parum maior, elliptica, angusta. Punctus niger sat maiusculus

adest sub primo articulo utriusque antennae. Antennae ferrugineae. Fastigium verticis ut in descriptione auctoris, in medio depresso-subconcauum.

Pronotum ferrugineum, incerte nebulosum, a supero visum subquadratum, sulcis superis modicis. Lobi laterales sensim longiores quam altiores, postice altiores, angulis oblique rotundatis, margine infero in parte antica leviter sinuato, margine postico subverticali sat alto, sinu humerali parum expresso; sulci U-formes et sulci postici optime impressi, intervalli gibbulosi. Margo posticus metazonae et inferus loborum lateralium subtilissime saturatius ferruginei.

Elytra ut in descriptione auctoris, apice subacute rotundata. Alae circiter ut in descriptione et figura originali, violascentes, fasciis transversis irregularibus magnarum macularum subrotundatarum tantum duabus (fig. 1): his maculis flavis, minime hyalinis.



Fig. 1

Gryllacris malayana Fritze.
Ala. Grand. nat.

Pedes longiusculi. Spinae solitae tibiarum anticarum valde elongatae. Tibiae posticae post maculam basalem superne planatae, utrinque spinis 7 fuscis, basi supra pallida, subtus fusca, sat longis, acutis, armatae, necnon spinis apicalibus solitis instructae.

Apex harum tibiarum breviter dilutissime infuscatus. Tarsi maiusculi.

Abdomen testaceo-ferrugineum. Segmentum octavum dorsale ♂ valde productum; segmentum nonum verticaliter decurvum, verticaliter sulcatum, fere subtiliter fissum, margine infero bigibbuloso. Cerci longi.

Questa specie credo vada collocata presso la *Gr. aethiops* Brunn.

Lo stesso Fritze ha descritto nella medesima opera anche una specie col nome di *Gr. elongata* (6, pag. 304, Taf. VII, fig. 3, ♂): questa mi pare potrebbe essere il ♂ della *Gr. funebris* Brunner 1898 (4, pag. 276, ♀), pure di Borneo.

***Gryllacris mauritiana* n. sp.**

♂. — Apud *Gryllacridem barombicam* Karsch locanda, a qua differt praecipue statura minore, femoribus posticis brevioribus.

Parva sed corpore crassiusculo; unicolor ferruginea, elytris alisque breviusculis, illis testaceis, venis venulisque concoloribus, his hyalinis, venis venulisque pallidis.

<i>Longitudo corporis</i>	mm. 16,4
" <i>pronoti</i>	" 4,1
" <i>elytrorum</i>	" 14,2
" <i>femorum anticorum</i>	" 5,8
" <i>femorum posticorum</i>	" 9,9
" <i>segmenti octavi abdominis</i>	" 1,8

Habitat: Insula Mauritius.

Typus: 1 ♂ (Musaei Universitatis in Oxford) nonnihil laesus.

Caput ab antico visum latiuscule ovoideum, nitidum. Vertex modice convexum; fastigium verticis latitudinem 1 $\frac{1}{2}$, primi articuli antennarum non attingens, primo articulo parum latius, marginibus obtuse rotundatis, superne incerte in medio fusco nebulosum. Maculae ocellares nullae. Frons transversa, sub lente parum punctulata; clypeus latiusculus, labrum, antennae, cum reliquo corpore concolora; palpi pallidiores; mandibulae ferrugineae apice infuscae.

Pronotum concolor, a supero visum sensim longius quam latius, margine antico in medio rotundato producto, sulcis antico et postico valliformibus, parum impressis, sulculo longitudinali abbreviato fossulari, margine postico transverso. Lobi laterales forma peculiari; parum longiores quam altiores, posterius altiores, margine antico toto rotundato, margine infero breviusculo, sensim sinuato, deinde angulum fere posticum inferius productum, vertice rotundato, efficiente; margine postico toto subarcuato obliquo (a solito angulo postico infero truncato et a solito margine postico verticali confecto, curvam unicam convexiusculam efficientibus), sinu humerali nullo. Sulcus V-formis et sulcus posticus bene impressi; intervalli gibbulosi.

Elytra sat parva, apicem femorum posticorum tamen attingentia, testacea, venis venulisque concoloribus vel partim pallidioribus. Alae sat parvae, subcycloideae, hyalinae, venis venulisque pallidis.

Pedes concolores, sat robusti. Tibiae anticae et intermediae solito modo spinosae, spinis longis. Femora postica crassa, ad apicem gradatim attenuata, parte attenuata etiam crassiuscula, subtus margine externo spinulis 5, margine interno spinulis

5-7, omnibus parvis et nigratis, armata. Articulatio femoro-tibialis, sub apice femoris, superne subtiliter atrata. Tibiae posticae longe post basim superne planiusculae, spinis parvis utrinque 6 nigro-fuscis armatae.

Abdomen concolor. Segmentum octavum modice productum, nonum cucullatum, inferius in medio leviter attenuatum prominulum, ibique subtus verisimiliter excavatum. Lamina subgenitalis ♂ parva, transversa, apice latiuscule rotundata, margine apicali in medio truncato-subsinuato: styli modici, cercorum dimidiam longitudinem aegre attingentes, depressiusculi, sulcati.

È specie certo prossima assai alla *Gr. barombica* Karsch della quale sono descritte solamente le ♀; senza dubbio però quando si conosceranno anche le ♀ di questa ed i ♂ di quella si potranno verificare differenze più sensibili, essendo le due specie provenienti da regioni molto lontane fra loro.

***Gryllacris conspersa* Br. subsp. *Brauni* Griffini.**

♂, ♀. — *Gryllacris conspersa* subsp. *Brauni* Griffini 1908. Le specie africane del gen. *Gryllacris* Serv., Studio monografico, Siena, pag. 43-44.

Due ♂ e una ♀. — Bay of Antongil, N. E. Madagascar, 1 IV. Mocquersys.

Questi esemplari mi giunsero più recentemente in un invio supplementare fattomi dal prof. Shelford, e disgraziatamente molto guasti. Non ho però alcun dubbio circa la loro determinazione; anche la disposizione dei punti oscuri della loro fronte corrisponde esattamente a quella da me descritta.

***Gryllacris Molineuxiana* Tepper.**

♂. — *Gryllacris Molineuxiana* Tepper 1892 (14¹, pag. 155 (1).

♂. — *Gryllacris Billinghami* Brancsik 1897 (1), pag. 84.

Due ♂: Adelaide.

Questa specie deve essere affinissima alla *Gr. straminea* Brunner: io vi riferisco gli esemplari del Museo di Oxford piuttosto che non alla *straminea*, pel colore nero piceo degli


(1) Recte: *Molineuxiana*, essendo la specie dedicata al sig. Molineux.

ultimi due segmenti addominali, che sono appunto indicati di questo colore nella *Molineusiana*, mentre dalla descrizione della *straminea* non appare che abbiano tinta diversa da quella del resto del corpo, inoltre per alcune particolarità degli organi situati all'apice dell'addome.

Quanto alla sinonimia che sopra stabilisco, io la credo evidente per chiunque legga attentamente le descrizioni, principalmente tenendo conto delle variazioni individuali e della poca importanza di certi caratteri, quale il numero delle spine dei femori posteriori; per me poi riesce tanto più evidente avendo sott'occhio gli esemplari del Museo di Oxford che ora descriverò, e che sono completamente intermedi fra i tipi descritti da Tepper e da Brancsik.

<i>Longitudo corporis</i>	mm.	18,5
" <i>pronoti</i>	"	4,4 — 4,6
" <i>elytrorum</i>	"	33,5 — 34,1
" <i>femorum anticorum</i>	"	5,8
" <i>femorum posticorum</i>	"	11,2 — 12,5
" <i>segmenti noni abdominis</i>	"	2,7

Pallide testaceo-straminea. Caput anterius planiusculum. Pars infera (anterior) fastigii verticis et frons sensim infuscatae; ocellus frontalis late ovatus, flavus, acute delineatus, superne rotundatus vel truncatus. Fastigium verticis latitudinem primi articuli antennarum parum superans, interdum eius latitudinem $1 \frac{1}{2}$ subattingens. Maculae fastigii verticis laterales, angustae, parvae, parum distinctae. Frons brevis, sub lente minute transverse rugulosa; clypeus et labrum sat maiuscula, rufo-testacea; palpi, antennae, testacea; mandibulae etiam rufo-testaceae, tantum apice intus nigratae.

Pronotum a supero visum latiusculum, subquadratum, totum unicolor, stramineum; margine antico in medio minime rotundato, sulco antico modice expresso, sulculo longitudinali abbreviato latiusculo, posterius cum sulco transverso optime expresso forma fere  coniuncto; sulculus transversus posterior post hunc sulcum adest, minus distinctus, a margine postico sat remotus; metazona leviter producta, margine postico subrotundato. Lobi laterales postice quam antice distincte altiores, breviusculi, margine postico verticali sat alto, sinu humerali modice expresso.

Elytra longa, sat ampla, latitudinem maximam circiter mm. 10,5 attingentia, apice subacuta, fere vitrea, levissime testaceo tincta, venis venulisque testaceis. Alae elongato triangulares, campo antico elytris simile, campo postico majori vitreo, venis venulisque pallidissimis.

Pedes testacei, tibiis omnibus (et praecipue posticis) basi breviter et parum saturate infuscatis: tibiae 4 anticae interdum superne rufescentes. Spinae tibiae 4 anticarum utrinque 5, modice longae, testaceae. Femora postica basi incrassata, apice breviter attenuata, subtus margine externo 6-spinuloso, margine interno 7-10 spinuloso, spinulis basalibus minoribus, omnibus sensim infuscatis, basi pallidioribus. Tibiae posticae superne post basim planato subsulcatae, spinulis sat maiusculis extus 7, intus 6, apice fuscis, armatae, necnon spinis apicalibus solitis instructae.

Segmenta abdominalia dorsalia duo ultima ♂ ut secundum descriptionem auctorum picea, producta, convexa; segmentum ultimum longius, apice subangulato-rotundatum, inferius excavatum. Lamina subgenitalis transversa, in medio denticulo posterius verso praedita, post stylos lobulis rotundatis. Styli longi sed sensim cercis breviores, apice rotundati.

Da questa descrizione si vedrà come i due ♂ del Museo di Oxford sieno perfettamente intermedi fra i tipi della *Gr. Molineuxiana* Tepper e della *Gr. Billinghami* Brancsik.

Concordano con entrambi pel colore, per la forma generale e per la struttura rimarchevole degli organi situati all'apice dell'addome. Concordano poi principalmente col tipo della *Molineuxiana* per la lunghezza delle elitre, e principalmente con quello della *Billinghami* pel colore brucicco della base delle tibie (carattere questo indicato anche per la *straminea* Br.).

La larghezza di 5 mm. indicata da Brancsik per le elitre del suo tipo deve essere erronea, perchè lo stesso autore nella descrizione parla di: « elytris latis », ora elitre lunghe 36 mm. e larghe appena 5, in un grillacride sarebbero anzi eccezionalmente sottili.

Il carattere indicato da Tepper: « Styles longer than cerci » forse non è preciso, o va inteso all'inverso, e potrebbe anche essere individuale pel tipo della sua specie. Brancsik non indica i rapporti di lunghezza fra i cerci e gli stili del suo tipo.

***Gryllacris subdebilis* Tepper.**

♀. — *Gryllacris subdebilis* Tepper 1892 (14), pag. 151-52. —
Kirby 1906 (11), pag. 146.

Due ♀. — Adelaide.

Non corrispondono proprio completamente alla descrizione di Tepper; nondimeno pei principali caratteri (lunghezza delle elitre e forma tutta particolare dell'ovopositore) credo doverli riferire a questa specie, distinguendoli solo come varietà. Quanto alla lunghezza del corpo, che qui apparirebbe considerevolmente maggiore, non è questo un carattere al quale si deva annettere notevole importanza, potendo il corpo nei diversi esemplari avere l'addome più o meno contratto od esteso.

var. *subecaadata* m.

♀. — *A specie typica differt praecipue femoribus posticis longioribus, fastigio verticis latitudinem 1 1/2, primi articuli antennarum tantum aegre attingente, necnon mandibulis cum reliquo capite concoloribus.*

<i>Longitudo corporis</i>	mm. 23,5 — 25 (abdomine extenso)
" <i>pronoti</i>	" 5
" <i>elytrorum</i>	" 20 — 22
" <i>femorum anticorum</i>	" 7,8 — 8
" <i>femorum posticorum</i>	" 14,5 — 15
" <i>ovipositoris</i>	" 7

Habitat: Adelaide.

Testaceo-ferruginea, unicolor, hic illic incerte dilute nebulosa.

Caput ab antico visum latiuscule ovoideum. Occiput et vertex convexa, leviter dilutissime cerebriforme nebulosa. Fastigium verticis latitudinem 1 1/2, primi articuli antennarum aegre attingens, lateribus leviter carinulatis. Frons sub lente punctulata et minutissime transverse rugulosa. Sulci suboculares perparum explicati. Clypeus interdum apice irregulariter infuscatus. Antennae, labrum, palpi, cum reliquo capite concolora. Mandibulae etiam ferrugineae, tantum summo apice (a labro in quiete oblecto) infuscato. Frons tota concolor, interdum in medio verticaliter levissime incerte infuscata; maculae ocellares nullae vel parum distinctae; in hoc casu omnes parvae subro-

tundae, flavae, et latera fastigii verticis ante maculas subverticaliter infuscata, dum fastigium frontis sat longe supra maculam frontalem incerte fusco bimaculatum.

Pronotum breve, a supero visum subquadratum, concolor vel incerte nebulosum. Margo anticus in medio rotundatim leviter prominulus; sulcus anticus sat distinctus quamvis parum impressus; sulculus longitudinalis abbreviatus depressionem latiusculam, minime profundam, efficiens: sulcus posticus valiformis distinctus: metazona levissime ascendens; margo posticus transversus, levissime concavus. Lobi laterales parum adpressi, multo longiores quam altiores, subrectangulares, sed angulis rotundato-subtruncatis, margine infero levissime sinuato, sinu humerali subnullo. Sulci V-formes acute impressi, sulci postici minus impressi; intervalli gibbulosi.

Elytra parum longa et parum lata, latitudinem maximam circiter mm. 6,3 attingentia, apice fere obtusa, leviter testaceo tincta, venis venulisque ferrugineis. Alae modicae, vitreae, venis venulisque ferrugineo-testaceis vel pallidis.

Pedes sat elongati, concolores vel dilute nebulosi. Tibiae anticae solito modo spinosae, spinis modice longis. Femora postica ad apicem sat longiuscule attenuata, subtus margine externo 2-spinuloso, margine interno 3-5 spinuloso, spinulis brevibus, apice fuscis. Tibiae posticae superne longe post basim planiusculae subsulcatae, spinulis minimis utrinque 5-9 apice fuscis; post basim annulus subtilis incertus dilute fuscus adest in his tibiis.

Abdomen saturate ferrugineum. Ovipositor insignis, parvus, exilis sed rigidus, brevis, falcato-incurvus, cum corpore concolor vel fuscus, ad apicem rapide suboblique acuminatus, apice acuto. Lamina subgenitalis ♀ subquadrata, angulis rotundatis, margine postico in medio leviter sinuato.

È notevole come finora di questa specie si conoscano soltanto ♀ e della precedente soltanto ♂; le differenze fra di esse sono però così grandi da rendere per ora inammissibile che la *Gr. subdebilis* possa essere la ♀ della *Gr. molineuxiana*.

***Gryllacris hyalina* Brunner.**

♀. — *Gryllacris hyalina* Brunner 1888 (2), pag. 361.

Un ♂ e una ♀. — Australia.

Un'altra ♀, molto guasta. — Nouvelle Hollande.

Kirby nel suo catalogo fa questa specie sinonima di *Gr. munda* Walker. Ma se la descrizione di Walker è esatta (del che si può anche dubitare fortemente) questa sinonimia non può essere ammessa, poichè Walker dà della sua *Gr. munda* le seguenti dimensioni: « Length of the body $10\frac{1}{2}$ lines, of the wings 24 lines », il che mostra già delle elitre lunghe oltre il doppio del corpo, corrispondendo circa il corpo a mm. 22,2 e le elitre a mm. 51.

Tali dimensioni non possono assolutamente convenire con quelle della *Gr. hyalina* Br., specie un po' minore e con elitre di gran lunga più brevi, lunghe circa 25 mm., ma potranno concordare con quelle di altre specie dagli organi del volo molto più sviluppati.

Gli esemplari del Museo di Oxford hanno la sommità del vertice del capo anteriormente oscura; eccone poi i principali caratteri:

	♂	♀
<i>Lunghezza del corpo</i>	mm. 16	16,2 — 18,3
" <i>del pronoto</i>	" 3,4	3,3 — 3,5
" <i>delle elitre</i>	" 25	24,1
" <i>dei femori anteriori</i>	" 4,9	5,1 — 5,3
" <i>dei femori posteriori</i>	" 9,5	9,5 — 10
" <i>dell'oropositore</i>	" —	13,7 — 15,1

Pallide straminea, capite fastigio verticis antierius infuscato, hoc colore superne ocellum frontalem flavum utrinque circumdante, necnon maculis duabus parvis vittaeformibus, fuscis, parum definitis, una sub utroque oculo et cum oculo contigua, praedito.

Caput ab antico visum ovatum-subcuneiforme, antierius depressiusculum; fastigium verticis latitudinem $1\frac{1}{2}$, primi articuli antennarum subattingens vel non attingens, quia interdum huius latitudinem parum superat, lateribus rotundatis, minime obtusis. Maculae ocellares verticis parvae, subrotundae, interdum parum distinctae: macula frontalis sat maiuscula, ovalis vel elliptica, interdum sulphurea, superne acutiuscula. Antennae totae, organa buccalia, cum reliquo capite straminea.

Pronotum breviusculum, concolor, margine antico rotundato minime producto, postico subrotundato, fere recto, optime limbatum; sulcus anticus, sulculus longitudinalis abbreviatus et sulci

2 postici transversi sat remoti, ante marginem posticum siti, modice impressi. Lobi laterales parum longiores quam altiores, postice altiores, margine postico verticali sat alto, sinu humerali parvo sed distincto; sulci V-formes bene impressi.

Elytra fere hyalina, ampla, latitudinem circiter mm. 8 attingentia, apice subrotundata, basi in medio leviter testaceo tincta. Alae parte antica elytris simile, leviter testacea, campo postico hyalino, leviter roseo tincto, venis venulisque pallidis.

Pedes concolores. Tibiae anticae solito modo spinosae, spinis modicis. Femora postica breviuscula, basi crassa, fere obesa, apice breviter attenuata, subtus margine interno usque ad 11-spinuloso, margine externo 5-spinuloso, spinulis omnibus apice fuscis et in utroque margine inter se sensim remotis. Tibiae posticae supra post basim planiusculae, spinulis utrinque 6, parvis, praeditae.

Segmenta abdominalia 2 ultima ♂ atra, producta; segmentum nonum longius, longitudinem 2 mm. subsuperans, apice subattenuatum, subrotundatum, subtus haud excavatum sed ibique leviter convexum. Lamina subgenitalis ♂ latiuscula et sat elongata, transverse subrectangularis, in medio denticulo elongato et apice rotundato praedita, utrinque stylo depresso latiusculo, apice rotundato, quam denticulo distincte longiore, instructa; post stylos et post denticulum, seu superne (si apex abdominis a supero conspicitur) lobus amplus depressus rotundatus, longitudine circiter denticuli, latitudinem ab uno ad alterum stylum extensam occupans, in medio sensim fissus, ideoque subbilobus, adest.

Ovipositor subrectus, minime incurvus, concolor, sat rigidus apice subacuminatus. Lamina subgenitalis ♀ subtriangularis, apice truncata, ibique levissime sinuata, lateribus fere callosis.

Paragryllacris combusta (Gerst.).

Gryllacris combusta Gerstaecker 1860 (7), pag. 267-68.

Paragryllacris combusta Brunner 1888, (2), pag. 370-71, Tab. IX, fig. 44 A. — Tepper 1892 (14), pag. 157. — Kirby 1906 (11), pag. 148-49 (cum Synonym.).

A — 1 ♂. — Sidney. C. Darwin.

B — 1 ♂. — New Ebrides. Capt. VI-IX. 1900 et pres. 1906 by I. I. Walker R. N.

È interessante la località in cui fu raccolto questo secondo esemplare. I due esemplari si somigliano perfettamente, solo in A la fascia longitudinale mediana oscura del pronoto è più irregolare, più pallida lungo il mezzo.

Lobi callosi laminae subgenitalis ♂ ad apicem denticulum extus praebent. Haec lamina, a supero visa, circiter in medio laminam verticalem incisam, lobis triangularibus erectis, cum apice dorsi abdominis contiguus, praebet.

***Paragryllacris Shelfordi* n. sp.**

♂. — *Verisimiliter apud P. callosam* Br. locanda. Ferruginea, fronte magna parte atra, segmentis abdominalibus dorsalibus basi fusco vittatis; venulis alarum ferrugineis, haud fusco circumdatis; lamina subgenitali ♂ basi lata, dein in lobum medium longum, latiusculum, ad apicem attenuatum sed ibi subtruncatum, producta, lobis lateralibus subbasalibus minimis.

<i>Longitudo corporis</i>	mm. 34	(abdomine extenso)
" <i>pronoti</i>	" 7,2	
" <i>elytrorum</i>	" 37	
" <i>femorum anticorum</i>	" 10,2	
" <i>femorum posticorum</i>	" 17	
" <i>laminae subgenitalis</i>	" 4,5	(circiter).

Habitat: Australia.

Typus: 1 ♂ (Musaei Universitatis in Oxford).

Corpus sat robustum, ferrugineum, pedibus concoloribus.

Caput ab antico visum fere orbiculare, crassiusculum. Vertex convexus. Fastigium verticis latitudinem 1 $\frac{1}{4}$, primi articuli antennarum attingens, haud superans, lateribus argute carinulatis. Frons punctata et crebre transverse rugulosa, utrinque sub antennis verticaliter tumidula, inferius punctis 2 maiusculis remotis impressis praedita. Sulci suboculares depressi, subplani. Clypeus et labrum modica.

Color capitis saturate ferrugineus; fronte magna parte atra: clypeo labroque ferrugineo-testaceis pallidioribus. Antennae concolores, ferrugineae. Vertex ferrugineus, lineola longitudinali media subtilissima atra et lineolis 2 lateralibus etiam atris, longitudinalibus sed irregularibus, posterius per arcum

transversum eodem modo subtilissimum, atrum, in occipite cum lineola media coniunctis, ornatus. Fastigium verticis anterius (inferius) nigrum, lineolis verticis in eo etiam expressis. Maculae ocellares fastigii verticis parvae, laterales, flavidae, modice distinctae. Genae ferrugineae; pars infera frontis supra clypeum transverse ferrugineo testacea; caeterum frons atra, in summo fastigio leviter pallidiore et utrinque, subito sub macula ocellari, macula parva subtili valde sinuosa testacea, modice distincta, ornata. Macula ocellaris frontalis ovata, flavida, bene delineata, dimidio oculo minor. Labrum pallidum; mandibulae basi ferrugineae, apice fuscae; palpi pallidi, articulo ultimo apice fusco.

Pronotum a supero visum latiusculum et sat longum, lobis lateralibus parum adpressis; pars supera longior quam latior: margo anticus testaceus, in medio rotundatim modice productus; caeterum pronotum ferrugineum, dilute nebulosum, lineola fusca a sulco antico retrorsum versa valde abbreviata, sulculum longitudinalem tantum attingente; sulcus anticus sat distinctus; sulculus longitudinalis abbreviatus latus, parum impressus, subelipticus, sulcus posticus subnullus, margo posticus rotundato-truncatus. Lobi laterales multo longiores quam altiores, oblique declivi, angulo antico obtuso fere recto, vertice rotundato, margine infero recto; sulcus late V-formis optime impressus, sulcus posticus parvus, intervalli gibbulosi.

Elytra subvitrea, leviter grisescentia, latitudinem maximam circiter mm. 12 attingentia, apice subobtusata, venis venulisque ferrugineis.

Alae subtriangulares, subhyalinae, levissime griseo tinctae, venis venulisque pallide ferrugineis, haud fuscis marginatis.

Pedes robusti, concolores, tibiis post basim annulo parvo leviter fusciori indistincto praeditis. Tibiae anticae solito modo spinosae, spinis modice longis. Femora postica basi crassa, ad apicem sat regulariter attenuata, subtus margine externo 4-spinuloso, margine interno 1-2 spinuloso; spinulis ad apicem sitis, omnibus apice fuscis. Tibiae posticae tantum in $\frac{2}{3}$ partes apicales superne leviter planiusculae, ibique spinulis parvis utrinque 4-5 apice fuscis armatae, necnon spinis apicalibus solitis instructae. Tarsi validi.

Abdomen ferrugineum, segmentis dorsalibus plurimis (apicalibus exceptis) basi fuscis. Segmentum octavum parum productum; segmentum nonum cucullatum, valde pubescens, margine

infero verisimiliter transverso, sed in typo inferius cum medio laminae subgenitalis contiguo, ideoque haud bene conspicendo. Lamina subgenitalis (fig. 2 S) longa, basi lata, sed lobo medio sub toto apicem abdominis superante; lobuli laterales perparvi; lobus medius latus, longus, apicem versus attenuatus, apice summo subtruncatus.



Fig. 2

E. Lamina subgenitalis
Paragrillacridis exsertae ♂.
S. Lamina subgenitalis
Paragrillacridis Shelfordi ♂.

La forma così particolare di (Ab infero visae; magnitudine auctae) questa lamina sottogenitale, molto diversa da quella delle specie congeneri, mi decide a descrivere la presente specie, benché la ♀ mi sia finora sconosciuta.

Ho il piacere di dedicare questa bella *Paragrillacris* al prof. R. Shelford, distintissimo entomologo.

***Paragrillacris* sp. n.**

1 ♀. — Albany. Brewer.

È affine alla *P. callosa* Br., ma va distinta per l'occipite dello stesso colore fulvo-ferrugineo del resto del capo, per le elitre ottusamente arrotondate all'apice, a venature ferruginee pallide, per le ali quasi jaline, a venature pallide.

Per alcuni caratteri potrebbe riferirsi alla *P. Tepperi* Kirby (= *insignis* Tepp. nec Walk.) di cui è descritto solo il ♂, e così pel colore pallido dell'occipite, per le vene pallide delle ali e per la struttura delle zampe, ma le dimensioni mi sembrano troppo differenti, essende il ♂ descritto con pronoto lungo mm. 3,5 e con elitre lunghe 40 mm.

Siccome nelle *Paragrillacris* la distinzione delle specie può farsi principalmente secondo i caratteri dei ♂, mentre riesce spesso assai difficile ed incerta per le ♀ non accompagnate dai relativi ♂, io descriverò questo esemplare senza darvi un nome. Aggiungo che mi pare impossibile che esso rappresenti la ♀ della *P. Shelfordi*.

<i>Longitudo corporis</i>	mm. 30,8
" <i>pronoti</i>	" 6,3
" <i>elytrorum</i>	" 27,2
" <i>femorum anticorum</i>	" 8,4
" <i>femorum posticorum</i>	" 15,2
" <i>ovipositoris</i>	" 34

Fulvo-ferruginea, unicolor, tantum hic illic incerte dilute nebulosa; fronte punctis duobus mediis nigricantibus et paucis punctulis aliis irregulariter positis etiam nigricantibus; pronoto superne post sulcum anticum lineola brevissima irregulari longitudinali incerta nigro-fusca signato.

Caput ovatum, pronoto minime latius. Vertex convexus. Fastigium verticis latitudinem $1 \frac{1}{2}$, primi articuli antennarum subsuperans, medio convexiusculum, utrinque depressiusculum, lateribus carinulatis. Maculae ocellares admodum indistinctae, nullae. Frons sub lente punctulata rugulosa; latera frontis sub antennis haud verticaliter prominula. Organa buccalia et antennae concolora.

Pronotum sensim longius quam latius, lobis lateralibus sat adpressis, humillimis. Margo anticus rotundato leviter productus; sulcus anticus optime distinctus; sulculus longitudinalis abbreviatus fossularis, perparum impressus; sulci postici ante marginem posticum 2 valliformes, parum impressi; metazona minime ascendens; margo posticus rotundato-truncatus. Lobi laterales valde longiores quam altiores, angulo antico subrecto, vertice rotundato, angulo postico truncato, margine postico verticali brevi, sinu humerali sat distincto.

Elytra levissime grisea, subhyalina, basi parum testacea, venis venulisque ferrugineis, latiuscula, latitudinem maximam circiter 10 mm. in medio attingentia, parum longa, apice obtuse latiuscule rotundata. Alae *subcycloideae*, fere vitreae, venis pallide ferrugineis, venulis pallidioribus, haud fusco circumdatis.

Pedes concolores. Tibiae 4 anticae solito modo spinosae, spinis haud multo longis, spina secunda quam prima sensim longiore. Femora postica basi *parum* incrassata, ad apicem sat longe attenuata, sulco externo longitudinali distincto, subtus apicem versus margine externo 3-spinuloso, margine interno 1-spinuloso, spinulis tantum summo apice fuscis. Tibiae posticae supra in dimidio apicali parum planatae, utrinque spinulis minimis apice fuscis instructae.

Segmenta abdominalia dorsalia basi incerte fusca. Ovipositor longus, angustus, rectus, apice acutissimus, ibique levissime fuscior. Lamina subgenitalis ♀ rotundata, utrinque basin versus plica crassa prominula, disco excavato.

Paragryllacris sp. β .

1 ♀. — Post Essington, Australia.

È molto affine alla *P. latelineolata* Br., ma ne differisce per l'ovopositore più corto, pei femori posteriori più brevi, per le elitre più lunghe e per le venule delle ali appena lievemente marginate di ferrugineo; presenta inoltre una struttura della fronte molto caratteristica:

<i>Longitudo corporis</i>	mm. 42 (abdomine extenso)
" <i>pronoti</i>	" 7,2
" <i>elytrorum</i>	" 48,3
" <i>femorum anticorum</i>	" 10
" <i>femorum posticorum</i>	" 17,7
" <i>ovipositoris</i>	" 33,5

Robusta; pallide flavido-testacea, arcu occipitis subtili irregulari leviter fuscior, sulco antico pronoti vittaque lata media a sulco antico ad marginem posticum extensa, antice posticeque dilatata, longitudinaliter a lineola media pallida fissa, leviter fuscis.

Caput maiusculum, ovoideum, pronoto latius. Occiput et vertex nitida, convexa: fastigium verticis latitudinem duplam primi articuli antennarum subattingens, nitidum, planiusculum lateribus carinulatis; maculae ocellares parvae, citrinae, sat distinctae. Frons cum fastigio *scaberrima*, rugosa, necnon sub utraque antenna *verticaliter valde prominula* fere utrinque carinato-tumida, et ad latera utriusque prominentiae verticaliter depressa. Genae maxima parte laeves. Clypeus inaequalis, rugosus, impressus; labrum apice infuscatum; mandibulae dimidio apicali intus nigratae. Palpi pallidi, articulo ultimo apice leviter fuscior. Antennae concolores.

Pronotum nitidum, a supero visum subquadratum, margine antico fere recto, in medio levissime rotundato, sulcis incertis paucis transversis brevibus eum sequentibus, sulco antico bene expresso, sulculo longitudinali abbreviato parum distincto, irregulari, sulcis duobus posticis ante marginem posticum sitis transversis, parum impressis, metazona sensim ascendente, margine postico truncato subconcavo. Lobi laterales humiles, subrectangulares, angulo antico subproducto sed vertice rotundato, sulco late V-formi optime impresso, sinu humerali parvo.

Elytra longa, apice subacuminata, subhyalina, leviter te-

staceo tincta, venis venulisque ferrugineis. Alae valde elongato triangulares, subvitreae, venis venulisque ferrugineis, his angustissime dilute ferrugineo marginatis.

Pedes concolores, basi tibiaram haud vel incertissime leviter obscuriore. Tibiae 4 anticae solito modo spinosae, spinis haud multo longis. Femora postica basi valde incrassata, extus leviter sulcata, ad apicem sat rapide attenuata, subtus margine externo spinis 3, margine interno spinis 3-4, acutis, apice nigris, armata. Tibiae posticae *fere inermes*, tantum apice leviter depressiusculae, tantum sub lente rudimentis quibusdam paucarum spinularum minimarum in margine externo apud apicem praeditae; spinae apicales adsunt.

Abdomen concolor, segmentis dorsalibus basi incerte infuscatis. Ovipositor angustus, elongatus, post medium levissime, indistincte, incurvus, apicem versus saturatius ferrugineus, apice acutissimus. Lamina subgenitalis ♀ subrotundata, apice in medio subtruncata, inferius carinis duabus mediis apicem versus divergentibus, basi convergentibus, fossulam basalem limitantibus, praedita.

Anomalia. Questo esemplare presenta una di quelle frequenti anomalie per riduzione d'una zampa di cui più volte mi sono occupato, e sulle quali sono ritornato diffusamente in un recente mio lavoro (¹).

Esso ha la zampa anteriore sinistra normale, la destra invece lievemente ridotta. È però questo il caso di meno visibile riduzione che io finora abbia osservato. Eccone le dimensioni.

	sinistra (normale) destra (ridotta)	
<i>Lunghezza del femore</i>	mm. 10	7,2
" <i>della tibia</i>	" 10,3	8,9
" <i>dei tarsi</i>	" 6,6	6

La differenza è molto lieve. Il femore è compresso alla base e va alquanto ingrossandosi verso l'apice. La tibia appare quasi normale, ma presenta solo due piccole spine presso l'apice sul margine esterno e 4 piccole spine tutte vicino all'apice sul margine interno. I tarsi sono ben conformati, ma alquanto piccoli.

(1) A. GRIFFINI. — *Di una varietà della Gryllacris taeta* Walk., e sopra un esemplare anormale di questa. Bollettino Mus. Zoolog. Anat. Comp. Torino, vol. XXIII n. 597, 1909. Con una incisione.

***Paragryllacris exserta* Brunner.**

♂. — *Paragryllacris exserta* Brunner 1888 (2), pag. 372. —
Tepper 1892 (14), pag. 160. — Kirby 1906 (11),
pag. 149.

♀. — *Paragryllacris exserta* Griffini 1908 (9), pag. 1-2.

Un ♂. — Australia.

L'esemplare è un po' mal conservato e corrisponde discretamente alla descrizione di Brunner; colla ♀ da me descritta concorda invero solamente per un numero limitato di caratteri, e può anche qui sorgere il dubbio dell'essersi riunite due specie differenti. Ma per quasi tutte le *Paragryllacris* occorreranno abbondanti materiali di studio per ben definire e distinguere le specie.

Ecco i caratteri di questo esemplare:

<i>Longitudo corporis</i>	mm. 26
" <i>pronoti</i>	" 5,1
" <i>clytrorum</i>	" 33
" <i>femorum anticorum</i>	" 8
" <i>femorum posticorum</i>	" 13,9
" <i>segmenti octavi abdominis</i>	" 2

Saturate ferruginea. Caput crassiusculum. Fastigium verticis latitudinem $1\frac{1}{2}$ primi articuli antennarum subsuperans, lateribus carinulatis superne divergentibus. Frons punctis impressis rugosa, utrinque sub antennis verticaliter tumidula, Clypeus, labrum, mandibulae, palpi, antennae, concolora.

Margo posticus pronoti incerte fuscior. Lobi laterales antice fere altiores quam postice, angulo antico subrecto, vertice rotundato, angulo postico oblique subtruncato, margine postico verticali brevissimo. Sulci V-formes optime impressi.

Elytra et alae ut in descriptione Brunneri.

Tibiae 4 anticae solito modo spinosae, spinis modicis (per exceptionem tibia dextra intus tantum 3 spinosa). Femora postica incrassata, parte apicali attenuata brevi, subtus margine externo 3-spinuloso, margine interno 4-5 spinuloso, spinulis apice fuscis. Tibiae posticae solito modo subrectae; superne post basim planiusculae, utrinque in dimidio apicali spinulis minimis 3 apice fuscis, praeditae.

Abdomen ferrugineum; segmenta apicalia concolora; segmentum octavum parabolico modice productum, segmentum

nonum cucullatum, posterius fere verticaliter rotundatim deflexum, apice subtruncatum, angulis leviter prominulis. Lamina subgenitalis ♂ (fig. 2 E) secundum descriptionem Brunneri confecta.

***Paragryllacris longa* (Walker).**

♀. — *Gryllacris longa* Walker 1869 (16), pag. 180.

♂, ♀. — *Paragryllacris pallidolinea* Tepper 1892 (14), p. 159-60.
Paragryllacris longa Kirby 1906 (11), pag. 149.

Una ♀. — Adelaide.

Corrisponde per quasi tutti i caratteri molto bene alle descrizioni originali. Le sue principali dimensioni sono le seguenti:

<i>Lunghezza del corpo</i>	mm. 34,5
" <i>del pronoto</i>	" 6,3
" <i>delle elitre</i>	" 39,5
" <i>dei femori anteriori</i>	" 9
" <i>dei femori posteriori</i>	" 17,2
" <i>dell'ovopositore</i>	" 36,2

Il fastigium verticis però raggiunge appena la larghezza $1 \frac{1}{2}$ del primo articolo delle antenne; gli angoli anteriori dei lobi laterali del pronoto sono quasi retti, a vertice rotondato, i solchi del dorso sono poco marcati, quelli V-formi dei lobi laterali sono bene impressi.

Le venule delle elitre sono ancor esse leggermente marginate di bruniccio, analogamente a quelle delle ali; elitre ed ali del resto sono quasi ialine: le ali hanno forma trasversalmente triangolare allungata.

I femori posteriori presentano molto distinto il solco lungo il lato esterno, ed hanno inferiormente da ambo i lati 3-4 piccole spine ad apice oscuro.

Le tibie posteriori nei $\frac{1}{3}$ apicali sono superiormente piane, con 4 minute spine sul margine esterno e 4-5 sul margine interno. Tutte le tibie sono piuttosto pallide, colla base brevemente e indistintamente tinta di bruniccio.

L'ovopositore è lungo, lievemente incurvo, ferrugineo. La lamina sottogenitale di questa ♀ è larga, arrotondata all'apice ove nel mezzo è lievissimamente sinuata, in modo quasi indistinto; ai lati e principalmente alla base essa presenta inferiormente come due grosse pieghe arcuate salienti, che alla base

quasi si toccano, le quali delimitano una sorta di larga depressione mediana della base stessa che appare quivi quasi scavata.

***Eremus sphinx* Gerst.**

♀. — *Gryllacris sphinx* Gerstaecker 1860 (7), pag. 278.

Eremus sphinx Brunner 1888 (2), pag. 378. — Kirby 1906 (11), pag. 151.

Brunner non ha conosciuto in natura questa specie, descritta da Gerstaecker come proveniente dal Capo di Buona Speranza; egli si è limitato a tradurre nella sua monografia la diagnosi originale.

Nelle collezioni del Museo di Oxford trovo un esemplare ♀ coll'indicazione: « Mauritius? », che si avvicina molto allo *Eremus sphinx*; per alcuni caratteri però merita di esserne distinto almeno come varietà:

var. ***Shelfordi* m.**

♀. — *A specie typica differt praecipue: ovipositore longissimo, corporis longitudinem subsuperante, necnon tibiis 4 anticis spinis utrinque tantum 3 (apicali excepta) praeditis.*

<i>Longitudo corporis</i>	mm. 17 (abdomine extenso)
" <i>pronoti</i>	" 3,5
" <i>femorum anticorum</i>	" 4
" <i>femorum posticorum</i>	" 8,8
" <i>ovipositoris</i>	" 19

Habitat: Mauritius (?).

Statura parva: apterus - Corpus subcylindricum, sat nitidum, unicolor testaceo-ferrugineum, segmentis dorsalibus thoracis tantum incertissime dilute nebulosis, posterius levissime irregulariter fuscioribus, ibique forsan omnibus pallido bimaculatis, segmentis abdominalibus basi incerte fuscioribus, apice incerte pallide marginatis.

Caput haud magnum, subangustum, pronoto tamen leviter latius, ab antico visum ovoideum. Occiput et vertex convexa. Fastigium verticis antierius planiusculum, sub lente minutissime rugulosum, latitudinem duplam primi articuli antennarum subattingens, ferrugineum, hoc colore utrinque per latera fastigii frontis in frontem verticaliter dilutissime incerte continuato.

Frons, clypeus, labrum, mandibulae, palpi, antennae, pallide testacea. Sulci suboculares subnulli. Frons transversa, sat nitida, punctis 2 sat proximis mediis impressis; clypeus et labrum subelongata.

Pronotum semicylindricum, a supero visum aequè latum ac longum, posterius subangustatum, margine antico leviter rotundato, margine postico sensim sinuato, sulco antico parum impresso, sulculo longitudinali elongato sed fere nullo, postico nullo. Lobi laterales parum adpressi, multo longiores quam altiores, subtrapetioidei, angulo antico rotundato, postico obtusissimo, margine postico obliquo, sinu humerali nullo.

Pedes concolores. Tibiae anticae et intermediae subtus in dimidio apicali utrinque spinis 3 haud longis armatae necnon spinis minoribus solitis praeditae. Femora postica crassa, parte apicali attenuata brevissima, subtus margine externo 5-spinuloso margine interno 4-spinuloso, spinulis apice fuscis. Tibiae posticae fere teretes, in dimidio apicali superne parum planatae, utrinque spinulis parvis, apice fuscis, 6 armatae, necnon spinis apicalibus solitis praeditae. Tarsi angustiusculi.

Segmenta abdominalia dorsalia ultima ♀ brevia. Cerci parvi. Ovipositor longissimus, subrectus, levissime incurvus, concolor, sat robustus, fere 1 mm. latus, apice acuto, latere fere usque ad $\frac{1}{2}$ mm. ante apicem, costula longitudinali obtusa depressiuscula instructus. Lamina subgenitalis trapetioidea, posterius attenuata, in medio obtuse distincte incisa, lobis rotundatis.

***Camptonotus Swinhoei* n. sp.**

? ♂. — *Gryllacris incerta* Walker 1869 (16), pag. 189 (sine patria)?

♂, ♀. — *Prima species australiana hujus generis americani, simillima C. jamaicensi* Brunner (2, p. 381, Tab. IX, fig. 47, *Neortus j.*).

Apterus; superne maxima parte piceo-castaneus vel castaneo ferrugineus; subtus, pedibus et facie pallidior; fastigiis verticis et frontis nigro-fuscis, maculis ocellaribus 3 pallidis parvis; tibiis anticis in dimidio apicali tantum utrinque 3-spinosis (spinis apicalibus exceptis), spinis breviusculis; femoribus posticis subtus ad apicem margine externo 3-spinoso, margine interno saepe inermi, raro 1-2 spinoso.

♂. — *Tibiis posticis, spinis apicalibus exceptis, inermibus;*

pedibus robustioribus, tarsis latioribus et maioribus. Lamina subgenitali maiuscula, latiuscula, mm. 3,3 longa, in medio subconstricta, dimidio apicali subtriangulariter late rotundato, stylis in medio insertis brevibus.

♀. — *Tibiis posticis spinis perparvis utrinque 5-8, apicalibus exceptis, praeditis; pedibus minus robustis, tarsis minoribus. Ovipositore omnino ut in fig. 47 Brunneri confecto, brevi, robustiusculo, lateribus rugulosis, in medio subdilato, usque parum ante apicem subrecto, seu basi minime incurvo, apice rapide angustato, acuto et incurvo; lamina subgenitali transversa, margine apicali late rotundato vel in medio subtruncato.*

	A	B	C
<i>Longitudo corporis</i>	mm. 25,4	25	18,8
" <i>pronoti</i>	" 5,2	5	4
" <i>femorum anticorum</i>	" 7,4	6,5	5,7
" <i>femorum posticorum</i>	" 12,4	13	11
" <i>ovipositoris</i>	" —	5,4	5,5

Habitat: Australia et Tasmania.

Typi. (Musaei Universitatis in Oxford): A. — 1 ♂, ex Australia.

B. — 1 ♀, ex Tasmania.

C. — 1 ♀, Buckland, Tasmania, ex coll. Swinhoe. (M. Burr collection, Pres. 1903 by M. B.).

Caput robustum tamen haud insolite magnum, in speciminibus maioribus latius, suborbiculare, in specimine minore C latiuscule ovoidem. Occiput ferrugineum; genae, frons, organa buccalia, antennae totae, ferrugineae; palpi pallidiores. Pars antica verticis et fastigia capitis nigro picea, hoc colore supra subtusque nebuloze terminato; maculae ocellares in ♀ punctiformes, in ♂ parum maiores (praecipue frontalis), flavae, distinctae.

Fastigium verticis convexiusculum, latitudinem duplam primi articuli antennarum attingens et superans (interdum triplam attingens). Frons sub lente punctulata et inferius transverse minute rugulosa, ibique utrinque impressa. Sulci suboculares adsunt, inferius dilatati.

Pronotum semicylindricum, breviusculum, quam caput angustius, margine antico late rotundato, margine postico in medio latiuscule sinuato, sulcis superis perparum distinctis, sulculo longitudinali abbreviato sat impresso, sulcis lorum lateralium melius impressis, intervallis gibbulosis. Lobi laterales

humiles, antice sensim quam postice altiores, margine infero ante coxas anticas minime sinuato, angulis late rotundato-truncatis, margine postico oblique rotundato, sinu humerali nullo.

Color pronoti piceus, parum et incerte ferrugineo nebulosus; in specimine minore C lineola longitudinali media ferruginea sat distincta, in dimidio antico cum maculis 2 lateralibus ferrugineis sat parvis parum distinctis contigua, et maculis 2 lateralibus circiter ad medium cum lineola non contiguis, etiam parum definitis, signatus. Margo totus circumcirca in speciminibus omnibus parum definite subtilissime ferrugineus.

Mesonotum et metanotum picea vel castanea, basi praecipue in medio pallidiora. Segmenta abdominalia dorsalia picea vel castanea; vel picea, dilute ferrugineo nebulosa. Segmenta abdominalia basalia in specimine B in medio longitudinaliter incerte angustequae pallidiora.

Pedes pilosuli, ferrugineo-castanei, incerte nebulosi, tarsis leviter pallidioribus; in ♀ graciliores. Tibiae 4 anticae in dimidio apicali tantum spinis utrinque 3 haud longis armatae.



Fig. 3

Camptonotus Swinhoei ♂.

A. Lamina subgenitalis ab infero visa.

B. Pars apicalis laminae subgenitalis (s) a supero visa, ultra apicem abdominis (ab) prominens.

(Magnitudine aucta).

Femora postica basi sat bene incrassata, ad apicem attenuata (in ♂ breviuscule), subtus margine externo 2-3 spinuloso, margine interno in ♀ ♀ mutico vel raro 1-spinuloso, in ♂ 1-2 spinuloso. Tibiae posticae longe post basim superne levissime planiusculae, fere teretes, in ♂ spinis apicalibus exceptis inermes, in ♀ spinulis parvis irregulariter positis utrin-

que 5-8 praeditae, apice incerte fuscis.

Segmentum abdominale dorsale ultimum ♂ piceum, productum, longitudinem 3 mm. attingens, convexum, leviter cucullatum, apice in medio leviter prominulo, lateribus inferius forsan transverse lobulatis. Cerci breviusculi, pallidi. Lamina subgenitalis (fig. 3) majuscula, ab infero visa longior quam latior, basi latior, circiter in medio sensim constricta, dein breviter dilatata, apice late subtriangulariter rotundato. Styli in parte subconstricta inserti, brevissimi. Dimidia pars apicalis hujus laminae ultra apicem abdominis prominula, a supero visa videtur longitudinaliter tumidulo-bicarinata, hoc irregulariter, et basi transverse quadrituberculata.

Ovipositor forma omnino ut in figura 47 Brunneri, leviter minor, brevis, robustiusculus, lateribus crebre rugulosis, rugulis apicem versus incerte oblique subparallelis, basi minus incurvus dein subrectus, post medium sensim dilatatus, apice rapide attenuato, acuto, incurvo: margo superus propterea sinuosus. Lamina subgenitalis transversa.

Ho descritto come nuova questa specie che mi pare estremamente simile al *C. jamaicensis* (Brunn.) poichè mi sembra impossibile che la specie della Giamaica viva cogli stessi caratteri nell'Australia e nella Tasmania.

Si potrebbe però supporre che i tipi descritti da Brunner fossero erroneamente indicati come provenienti dalla Giamaica e fossero invece originarii della Tasmania; allora le probabilità di sinonimia aumenterebbero grandemente. I caratteri della lamina sottogenitale del ♂ mi sembrano abbastanza rimarchevoli e tipici per questa specie, così separata dalle altre congeneri, tutte americane.

Quanto alla sinonimia con *Gryllacris incerta* Walker, specie che da Kirby nel suo catalogo è assegnata al genere *Eremus*, io l'ho indicata qui in modo molto dubitativo, poichè come al solito le disgraziate descrizioni di Walker lasciano nella massima incertezza.

Mi sono ancora ripetutamente domandato se la specie qui descritta non fosse l'*Apotrechus ambulans* (Er.), indicato appunto della Tasmania, e che io non conosco in natura; le descrizioni che ne son date dagli autori e la lunghezza dall'ovopositore (indicata di 17 mm.) mi sembrano caratterizzare però una specie notevolmente distinta.

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*Two new Species of Gryllacris in the University Museum,
Oxford.* By Dr. ACHILLE GRIFFINI (R. Istituto tecnico,
Genova, Italy).

I HAVE recently received for identification from the Hope Department, University Museum, Oxford, owing to the courtesy of Professor E. B. Poulton, F.R.S., and Mr. R. Shelford, a series of undetermined Gryllacridæ. In a memoir of some length, communicated to the Società Italiana di Scienze Naturali in Milano at its session of January 31st, 1909, I have described the African, Indo-Malayan, and Australian species of this family of Locustodea in the Oxford Museum collection. The following account treats of the only two Neotropical species in this collection; the species evidently are new to science, and one (*Gryllacris longstaffi*) is highly remarkable on account of the extraordinary structure of the apex of the abdomen, and of the external genitalia of the male.

I seize this opportunity to express my sincere thanks to Professor Poulton for permitting me to examine this interesting collection, and in particular to Mr. R. Shelford for the trouble he has taken in transmitting the specimens to me and in

supplying me with all the information concerning them that I required.

Gryllacris longstaffi, sp. n.

Apud *Gryllacridem ablutam*, Brunn., locanda. Statura modica: testacea nitida; capitis vertice anterieus cum fastigio, cum parte supera frontis et cum primis 4 articulis antennarum colore atro, hoc colore præcipue inferius a colore testaceo reliqui capitis bene diviso, maculis ocellaribus nullis; pedibus unicoloribus testaceis, spinulis pedum posticorum fuscis basi pallidioribus; elytris apicem femorum posticorum tantum attingentibus, testaceis, venis venulisque concoloribus, leviter pallidioribus; alis albido-hyalinis, venis venulisque albidis.

♂. Abdomine segmentis dorsalibus brevibus, excepto ultimo abnorme permagno, ejus lateribus inflatis posterius subtusque magis productis; parte supera hujus segmenti posterius in medio lobum supraanalem perlongum, retrorsum versum gerente, hoc lobo basi petiolato, dein laminam magnam subtriangularem angulis rotundatis, lateribus et margine postico deflexis, apicem cercorum tegentem, efficiente; parte postica magni segmenti ultimi abdominis sub lobo ample excavata; lateribus inferis eiusdem segmenti in appendices cerciferas magnas bicornutas posterius inter se cruciatis, retrorsum et sursum versas, partim a lobo supraanali tectas, productis; lamina subgenitali transversa, margine postico latissime sinuato, lobis omnino lateralibus posterius versis, apice angustis, stylos breves depressiuseulos, apice rotundatos, gerentibus, vel (forsan per exceptionem) interdum stylis destitutis.

	mm.
Longitudo corporis	20·6-21·5
„ pronoti	4·5-4·7
„ elytrorum	16·5-17·2
„ femorum anticorum	6·3-7
„ „ posticorum	11·1-11·9
„ segmenti abdominalis ultimi cum lobo	7·6

Habitat. Jamaica.

Typi: 2 ♂ (Musæi Universitatis in Oxford) a D. G. B. Longstaff anno 1907 collecti et donati.

Typus *A* (fig. 1, 5, 6), indicationem: "Jamaica, below 50 feet, Portland, Port Antonio, capt. Feb. 26-07" gerens.

Typus *B* (fig. 2, 3, 4, 7), indicationem: "Jamaica, about 2700 ft., Manchester, Walderston, capt. Feb. 7-07, at light" gerens.

Species propter notas sexuales ♂ valde miranda, forsán typus novi generis sine cognitione ♀ tamen adhuc non instituendi.

Color testaceo-flavidus nitidus, pulcher; corpus parum robustum.

Caput ab antico visum ovoideum, pronoto minime latius. Occiput et vertex convexa: fastigium verticis rotundatum, articulo primo antennarum parum latius, hujus latitudinem $1\frac{1}{2}$ non attingens. Frons inferius supra clypeum depressa, præcipue utrinque; sulci suboculares nulli; clypeus et labrum subelongata.

Occiput pallide testaceo-cinereum. Vertex cum fastigio verticis, cum fastigio frontis et cum dimidia (vel fere dimidia) parte supra frontis, colore atro nitido, sine maculis ocellaribus; hoc colore subtiliter etiam oculos supra subtusque partim circumdante, a colore pallido bene diviso (seu in colorem pallidum haud dilute transeunte). Pars infera coloris atri frontis in medio sinuata vel in medio utrinque angulo brevi inferius producta. Genæ, dimidia pars infera frontis, cum clypeo, labro, mandibulis, palpisque, testacea, leviter nebulosa; labrum interdum leviter fuscus. Articuli 3 primi antennarum toti atri; articulus quartus atro-fuscus, articuli 5-7 testacei interdum leviter fuscus, cæteri testacei.

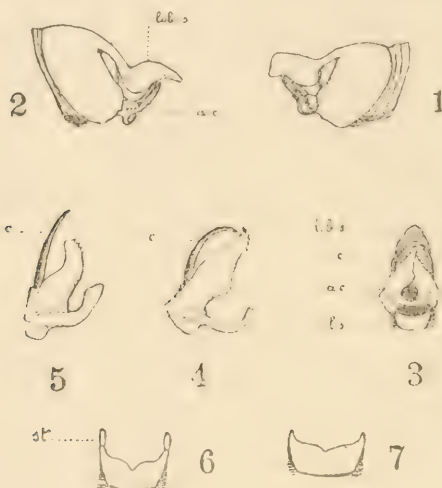
Pronotum a supero visum subquadratum, convexum, robustiusculum, marginibus antico et postico leviter et late rotundatis; sulco antico valliforme bene expresso; sulculo longitudinali abbreviato parum distincto, antice posticeque fossulari; sulco postico nullo seu ante limbum extremum marginis postici sito; metazona non ascendens. Lobi laterales humiles, subrectangulares, multo longiores quam altiores, parum adpressi, angulis rotundato-truncatis, margine infero sensim sinuato, margine postico subrotundato-verticali, leviter obliquo, sinu humerali nullo (metazona postice minime producta). Sulcus V-formis et sulcus posticus sat bene expressi; intervalli gibbulosi. Color pronoti pallide testaceus, nitidus, leviter nebulosus, supra incertissime pallide trivittatus.

Elytra modica, fere lanceolata, apicem femorum posticorum ægre superantia, testacea nitida, venis venulisque concoloribus vel partim pallidioribus, latitudinem maximam mm. 6.5 parum post medium subattingentia, apice subacute rotundata. Alæ cycloideæ, albido-hyalinæ, leviter roseo tinctæ, venis venulisque albidis.

Pedes modici, testacei, imo condylo articulari tibiæ posticarum tantum interdum incerte dilute fusciores. Tibiæ 4 anticæ solito modo spinosæ, spinis utrinque 4 modice longis, apicem versus longitudine parum decrescentibus. Femora postica breviuscula, basi valde incrassata, apice breviter attenuata sed ibi angustata, subtus margine externo 6-7 spinuloso, margine interno 4-6 spinuloso, spinulis apicalibus

fortioribus, fuscis vel tantum apice fuscis, basi pallidis. Tibiæ posticæ superne longe post basim leviter planiusculæ, ibique in utroque margine spinis 4, apice fuscis, armatæ; necnon spinis apicalibus solitis instructæ. Tarsi longiusculi, modice lati.

Abdomen concolor, testaceum, nitidum. Segmenta dorsalia ♂ ante-ultima inusitate brevissima, præcipue superne; segmentum dorsale ultimum ♂ inusitate permagnum, nitidissimum, convexum, utrinque posterius et inferius magis



1. Apex abdominis speciminis *A*, a latere visus.
2. Apex abdominis speciminis *B*, a latere visus: *lob. s.*, lobus supra-analis; *a. c.*, appendix cercifera.
3. Apex abdominis speciminis *B* ab infero visus: *lob. s.*, lobus supra-analis; *c.*, cercus; *a. c.*, appendix cercifera; *l. s.*, lamina subgenitalis.
4. Appendix cercifera sinistra speciminis *B*: *c.*, cercus.
5. Appendix cercifera sinistra speciminis *A*: *c.*, cercus.
6. Lamina subgenitalis speciminis *A*: *st.*, styli.
7. Lamina subgenitalis speciminis *B*.

(Figure omnes magnitudine auctæ.)

productum. Pars supera hujus magni segmenti (fig. 1, 2) posterius lobum supraanalem longum (fig. *lob. s.*) retrorsum versum præbet, petiolatum (petiolo sensim decurvo), in laminam irregulariter subtriangularem convexam, angulis rotundatis, lateribus deflexis, apice in specimine *A* (fig. 1) etiam cucullato deflexo, in specimine *B* (fig. 2) multo minus

deflexo, fere horizontali, semper tamen apicem cercorum tegentem et subamplectentem, terminatum. Sub basi huius majusculæ laminæ appendiculus medius videtur oblique in intimis partibus descendens, subtilis, verisimiliter cum basi laminæ ipsæ superne coniunctus. Sub lobo supraanali nunc descripto apex segmenti ultimi magni dorsalis ample excavatus. Utrumque latus (inferius et posterius productum) huius segmenti appendicem cerciferam (fig. *a. c.*) magnam retrorsum et sursum versam præbet. Appendices cerciferæ sunt bicornutæ, primo intuitu videntur tricornutæ, quia cercum (fig. *c*) in latere externo sursum versum etiam præbent; hæc appendices partim inter se sunt cruciatæ (fig. *3*), sinistra semper supra dextram partim superposita, apicem versus, et partim a lamina lobi supraanalis apice sunt tectæ. Forma appendicis cerciferæ sensim differens in duobus typis (vide fig. 4 et 5); in utroque specimine tamen cornus inferum angustius, curvatum, subfalcatum, basi decurvum, apice incurvum, apice obtuso vel leviter dilatato; cornus superius latius, fere laminare, contortum, sursum versum, apice et intus minute pluridenticulatum, denticulis partim fuscis; huius basis superne extus cercum longum pilosum gerens.

Lamina subgenitalis ♂ transversa, margine postico latissime sinuato, in medio leviter angulariter inciso, lobis omnino lateralibus posterius versis, apice angustis, brevibus; hi lobi in specimine *A* (fig. 6), quod typicum normale esse puto, stylos breves, depressiusculos, apice subrotundatos (fig. 6, *st.*) præbent; in specimine *B* (fig. 7), quod anormale esse puto, magis acuti, stylis sunt destituti.

Hæc species, propter nonnullas notas, speciebus generis *Dibelonæ*, Br., appropinquatur.

Gryllacris sancti-vincentii, sp. n.

♂. Parva; testaceo-ferruginea concolor (vel pedibus intermediis saturatius ferrugineis?), graciliuscula; elytris hyalinis sensim testaceo tinctis, venis venulisque concoloribus; alis albido-hyalinis, venulis pallidis; tibiis anticis et intermediis subtus utrinque tantum spinis 2-3 breviusculis armatis; tibiis posticis, exceptis spinis apicalibus, inermibus.

	mm.
Longitudo corporis	16
„ pronoti	3·6
„ elytrorum	15
„ femorum anticorum	5·7
„ „ posticorum	9·8
„ segmenti octavi abdominis	1·9

Habitat. Insula Sancti Vincentii (W. Indiæ, teste *Shelford*).

Typus: 1 ♂ (Musæi Universitatis in Oxford), nonnihil læsus.

Inter *Gr. eximiam*, Karsch, et *Gr. exiguam*, Br., locanda.—Corpus statura parva, parum robustum, testaceo-ferrugineum, pedibus (exceptis intermediis in typo forsan per notam individualem saturatius ferrugineis) concoloribus.

Caput unicolor, pallide testaceo-ferrugineum, ab antico visum ovoideum, pronoto modice latius. Vertex nitidus, convexus; fastigium verticis rotundatum, latitudinem $1\frac{1}{2}$ primi articuli antennarum subsuperans; maculæ ocellares nullæ. Frons inferius in medio impressa. Organa buccalia, solito modo confecta, et antennæ cum reliquo capite concolora.

Pronotum (in typo læsum) forsan posterius in medio et utrinque dilute fusco pictum, nebulis obliquis; a superno visum subquadratum; margine antico rotundato, sed in medio non producto; sulco antico valliforme, in medio subnullo. Lobi laterales parum longiores quam altiores, postice leviter altiores, angulo postico subtruncato, margine postico subverticali leviter retrorsum obliquo, sinu humerali subnullo; sulci bene impressi, intervalli gibbulosi.

Elytra parum longa, subhyalina, leviter testaceo tincta, venis venulisque concoloribus. Alæ albido-hyalinæ, venis venulisque pallidis.

Pedes testaceo-ferruginei (intermedii fusco-ferruginei). Tibiæ 4 anticæ subtus utrinque spinis parvis 2-3 præditæ. Femora postica basi crassa, apice breviuscule sed distincte attenuata, subtus margine externo 5-spinuloso, margine interno 2-3-spinuloso, spinulis in dimidio apicali sitis, apice brevissime incerte fuscis. Tibiæ posticæ exiles, fere teretes, superne inermes, vel rudimento tantum spinulæ unicæ circiter in medio marginis interni, vel etiam, sub lente, gibbulis quibusdam minutissimis, locum spinularum perpaucarum omnino rudimentalium indicantibus, præditæ.

Abdomen concolor. Segmentum octavum dorsale modice productum; segmentum nonum productum, parum cucullatum, posterius in medio bispinulosum. Lamina subgenitalis ♂ verisimiliter subquadrata, apice latiuscule rotundato, margine apicali in medio sat acute exciso.

Genoa,

Feb. 4th, 1909.

Révision des types de certaines *Gryllacris* décrites par F. Walker, existant au Musée d'Oxford. (Orth.)

Par le Dr. Achille Griffini, Genova.

La révision des types des espèces décrites par certains anciens auteurs est un travail nécessaire pour les bonnes études systématiques; donner de nouvelles descriptions et faire mieux connaître ces types, dont les diagnoses originelles sont souvent absolument insuffisantes ou même en certains cas erronées, c'est extrêmement utile pour la détermination des espèces correspondantes, pour éviter des doutes ennuyeuses et des erreurs.

Dans l'ordre des Orthoptères, s'il y a des espèces dont la révision des types est principalement nécessaire, ce sont les nombreuses espèces décrites par F. Walker, d'une façon tellement imparfaite et limitée, et souvent tellement défectueuse, que les auteurs ont été obligés jusqu'à présent, à ne pas les prendre en considération (contrairement aux lois de priorité), étant généralement presque impossible par l'étude des diagnoses du dit auteur d'arriver à se former une idée exacte des types qu'il a décrit.

Et pourtant, Brunner v. Wattenwyl lui aussi, dans ses Monographies magistrales sur les Orthoptères, a dû ne pas s'occuper des descriptions de Walker, de façon qu'il a eu inévitablement à décrire comme nouvelles des espèces déjà publiées par cet auteur.

Les types de Walker sont en très-grande partie au British Museum de London, en petite partie au Musée Zoologique Universitaire de Oxford (Grande Bretagne).

Récemment M^r le Dr. Kirby, ayant heureusement sous les yeux, au British Museum, la plus grande partie des types de Walker, a dans son Catalogue des Orthoptères pris en considération les espèces de cet auteur, déterminant certaines synonymies et donnant aux espèces une position systématique provisoire, généralement satisfaisante. Mais un Catalogue n'est qu'une succession de noms et d'indications, et donc les nombreuses espèces de Walker qui ne sont pas synonymes d'autres mieux décrites ensuite, sont encore problématiques.

M'occupant depuis quelque temps de l'étude de la famille des *Gryllacridae*, j'ai eu à demander plusieurs fois soit à M^r Kirby du British Museum, soit à M^r Shelford du Musée d'Oxford, quelque renseignement sur les caractères de certains types de Walker, renseignements qui m'ont été donnés toujours avec grande aimabilité et grand empressement, et dont je remercie ici

encore une fois les entomologistes distingués qui ont bien voulu me les donner.

M^r Shelford dans une de ses lettres m'envoyait la liste des types des *Gryllacris* décrites par Walker existant au Musée d'Oxford, et m'indiquait à leur égard quelques synonymies.

Voici quelles sont ces espèces :

1. *Gr. atrata* Walker.
2. (*Gr. scita* Walker) = *Gr. frontalis* Burmeister.
NB. Synonymie déjà établie par Kirby.
3. *Gr. marginata* Walker.
4. *Gr. venosa* Walker.
5. *Gr. gracilis* Walker (= *Gr. vittata* Brunner).
NB. Synonymie déjà établie par Kirby.
6. *Gr. nobilis* Walker (= *Gr. lugubris* Brunner).
NB. Synonymie établie par Shelford et dont j'ai déjà parlé dans un de mes derniers travaux ¹⁾.
7. (*Gr. fumosa* Walker) = *Gr. nigrilabris* Gerstaecker.
NB. Synonymie établie par Shelford et dont aussi j'ai déjà parlé dans mon travail sus-indiqué.
8. (*Gr. piceifrons* Walker) = *Gr. heros* Gerstaecker.
NB. Synonymie déjà établie par Kirby. De cette espèce encore est synonyme la *Gr. fuscifrons* Walker nec Gerst., selon ce que m'écrit M^r Shelford.
9. *Gr. punctipennis* Walker.
10. *Gr. viridescens* Walker.
11. *Gr. macrocera* Walker.

Dernièrement enfin, avec aimable empressement, dont je ne saurais combien remercier M^r le prof. Poulton, le Musée d'Oxford m'a envoyé en communication les types de quelques-unes des susdites espèces, savoir des suivantes: *atrata*, *marginata*, *venosa*, *punctipennis* et *macrocera*, et un cotype de la *gracilis* (Le type de la *viridescens*, m'écrit M. Shelford, est tellement en mauvaises conditions, qu'on ne peut l'exposer aux périls d'un voyage).

Comme j'ai déjà fait pour les types de Stål, qui m'ont été aimablement communiqués par M^r le prof. Sjöstedt du Musée de Stockholm ²⁾, j'ai donc étudié avec tous les soins les types de Walker que j'ai reçus, et dans ce travail j'expose le résultat de mes études. Des espèces pour lesquelles c'était nécessaire, je

¹⁾ Studi sui Grillacridi del Museo di Oxford. Parte 1^a. Specie etiopiche, indo-malesi ed australiane. Atti Soc. ital. Scienze Natur. Milano, vol. XLVII, 1909.

²⁾ Voir mon mémoire: „Le *Gryllacris* descritte da C. Stål“, Atti della Società Italiana di Scienze Naturali, Milano, Vol. XLVIII.

donne une nouvelle et longue description, nécessaire pour leur détermination, particulièrement dans un genre comme celui-ci, riche déjà de plus que 200 espèces.

Observation. Tous les types de Walker que j'ai vu, portent une étiquette avec l'indication: „E. coll. (1830—73) W. W. Saunders. Purchased and pres, 73 by Mrs. J. W. Hope.“

Gryllacris atrata Walker.

♂. *Gryllacris atrata* Walker 1869, Catalogue of the spec. of Dermaptera Saltat. British Museum, London, p. 174—75. — Kirby 1906, Synonym. Catalogue of Orthoptera, vol. II, part I. London, p. 140.

Typus *Walkeri*:

♂. *Apud Gr. funebrem* Brunner locata, sed propter notas alarum etiam *Gr. nigripenni* Gerst. proxima; distinctissima tamen pulchra species, propter picturam elytrorum miranda. — Atrata, nitida; capite pallidior, vertice fusco, facie antennisque testaceis; pronoto atro-castaneo, maculis paucis ferrugineis; pedibus atris, dimidio basali femorum omnium rufotestaceo; elytris fusco-nigris, in dimidio basali venis ipsis et venulis ipsis hyalinis, et subtilissime utrinque hyalino marginatis, in dimidio apicali venis fuscis, venulis leviter fuscis extus tantum subtilissime hyalino marginatis; alis fusco-nigris, venis fuscis, venulis fuscis subtilissime extus hyalino marginatis (sub lente etiam intus incerte subtilissime pallido marginatis).

Longitudo corporis 26 mm, pronoti 6 mm, elytrorum 28 mm, femorum anticorum 8,8 mm, femorum posticorum 15,6 mm.

Habitat: Sarawak.

Corpus statura modica, sat robustum, nitidum.

Caput pronoto sensim latius, ab antico visum ovoideum. Occiput et vertex optime convexa. Fastigium verticis anteriorius depressum, latitudinem $1\frac{1}{2}$ primi articuli antennarum haud superans, marginibus lateralibus crassiuscule carinulatis, subparallelis, scutello medio depressiusculo sat delineato et distincto, margine infero concaviusculo, margine supero leviter prominulo, angulum superum acutum (vertice superne verso) efficiente, notando. Maculae ocellares haud distinguendae. Frons inferiorius depressiuscula, sub lente parum punctulata; sulci suboculares optime distincti.

Vertex fuscus nitidus, anteriorius dilutior; genae post oculos magis fuscae, inferiorius et margine postico dilutiores; lineola superior pallida post verticem superum utriusque oculi ad marginem anticum pronoti extensa conspicitur. Fastigium verticis et frons testacea; labrum, clypeus et basis mandibularum testaceo-ferruginea; palpi extus obscuriores, picescentes. Antennae testaceae articulo primo basi et apice leviter infuscati.

Pronotum nitidum, a supero visum leviter longius quam latius, anterieus compressiusculum, lobis lateralibus sat adpressis. Margo anticus rotundatus: sulcus anticus valliformis bene expressus, sulculus longitudinalis abbreviatus latiusculus sed parum expressus; metazona inaequalis, margine postico leviter ascendente, subtruncato. Lobi laterales longiores quam altiores, postice minime altiores, margine infero haud sinuato sed fere late rotundato, angulo postico rotundato-subtruncato, margine postico verticali sat alto, sinu humerali expresso, sulcis solitis bene impressis, intervallis gibbulosis.

Color pronoti atro-castaneus; superne parum pone medium utrinque macula sat parva ferruginea sat distincta conspicitur, dum lineola media et maculae anteriores obscure ferrugineae multo minus sunt distinguendae.

Elytra modice elongata, apice obtuse rotundata, latitudinem maximum circiter mm 10,8 attingentia, fusco-nigra, tamen haud opaca. In dimidio basali elytrorum venae et venulae ipsae sunt pallidissimae, testaceo-hyalinae, atque utrinque subtilissime hyalino marginatae, ideoque in dimidio basali elytra videntur pallido regulariter reticulata. Ad medium venae et venulae sat rapide (tamen haud subito) colore fusco tinguntur: in dimidio apicali elytrorum venae sunt nigro-fuscae, areolis obscuriores, et haud pallido marginatae, venulae sunt minus fuscae, circiter colore areolarum, et extus tantum subtilissime hyalino marginatae.

Alae nigro-fuscae, tamen haud opacae; amplae, modice longae, venis venulisque nigro-fuscis, his extus subtilissime albido-hyalino marginatis et sub lente etiam intus (incertissime tamen).

Coxae fuscae, inferius rufo-testaceae. Pedes antici graciliusculi; postici robusti. Femora dimidio basali rufo-testacea, dimidio apicali cum tibiis tarsisque totis atra. Tibiae 4 anticae solito modo spinosae, spinis haud longis. Femora postica basi valde incrassata, sulco externo bene impresso, dimidio apicali regulariter attenuata, subtus in utroque margine usque ad 11 spinulosa, spinis apicem versus sitis fortioribus, ibique (in parte atra) atris, in parte basali rufo-testacea rufo-testaceis. Tibiae posticae robustae, superne post basim planiusculae, spinis in margine externo 7, in margine interno 6, cum tibiis totis atris.

Abdomen castaneum, apice atrum nitidum. Segmentum octavum dorsale ♂ minime plus quam septimum productum: segmentum nonum convexum, subcucullatum, inferius leviter attenuatum, sub lente minute transverse rugulosum, margine apicali lateraliter concaviusculo, in medio latiuscule sed levissime prominulo et in

medio huius partis subtruncato, forsan minime sinuato. Lamina subgenitalis in typo laesa.

Belle et remarquable espèce, très distinguée, qui paraît n'avoir plus été retrouvée.

Gryllacris venosa Walker.

♀. *Gryllacris venosa* Walker 1869, Op. cit., p. 185. — Kirby 1906, Catal. cit., p. 143.

Typus Walkeri:

♀. *In divisionem 1, 2.2, Systematis Brunneri locanda, inter Gr. frontalem* Burm. *et Gr. lineolatam* Serv., *tamen valde differens et distincta. Statura modica: robusta; testaceo-ferruginea unicolor; pronoto valde inaequali; elytris albido-subhyalinis, venis venulisque omnibus atris crassiusculis (subtillime etiam atro marginatis); alis hyalino-albidis, venis venulisque ferrugineo-fuscis, his latiusculis et anguste ferrugineo marginatis; ovipositore parum longo.*

Longitudo corporis 28 mm, pronoti 7,6 mm, elytrorum 26 mm, femorum anticorum 8,5 mm, femorum posticorum 15,2 mm, ovipositoris 13,8 mm.

Habitat: Sarawak.

Corpus statura modica, robustum, testaceo-ferrugineum, sub-unicolor, pronoto levissime fusciori, rufo-ferrugineo, pedibus concoloribus.

Caput pronoto minime latius, ab antico visum ovatum-orbiculare. Occiput et vertex optime convexa. Fastigium verticis minus convexum, latitudinem $1\frac{1}{2}$ primi articuli antennarum sensim superans, rotundatum, lateribus ubi maculae ocellares adsunt tumidis. Maculae ocellares distinctae, albae; macula ocellaris frontalis haud maior quam maculae verticis, minus bene delineata, flava. Frons sat aequalis, inferius depressiuscula; sulci suboculares modice expressi, inferius latiusculi. Clypeus et labrum sat brevia.

Color capitis testaceo-ferrugineus; occipite nitidiore fulvescente, leviter nebuloso; labro levissime fusciori, organis buccalibus et antennis concoloribus.

Pronotum insolite robustum, a supero visum subquadratum, lobis lateralibus sat adpressis. Margo anticus in medio rotundatus sed perparum productus; sulcus anticus valliformis optime impressus; sulculus abbreviatus longitudinalis parum distinctus; sulci transversi 2 ante marginem posticum adsunt sat proximi, quorum posterior ad limbum posticum situs; inter eos metazona transverse est fere carinata, prominula. Post sulcum anticum valliformem tumescentiae duo mediae (una utrinque) adsunt et tumescentiae duo laterales anticae in deflexione lorum lateralium;

post tumescentias medias anticas tumescentiae duo minores, magis approximatae, ante metazonam tumescentiae duo parvae sed bene prominulae, mediae, subobliquae, et tumescentiae duo laterales gibbosae, conspiciuntur. Margo posticus truncatus, in medio sensim sinuatus. Lobi laterales postice quam antice altiores, distincte longiores quam altiores: angulo antico optime rotundato. margine infero posterius sinuato, ideoque angulo postico bene expresso, inferius rotundato-subprominulo; margine postico toto obliquo subundulato, inferius leviter sinuato, in medio subrotundato, superne subsinuato, sed sinu humerali admodum indistincto; sulci soliti optime expressi; intervalli valde gibbulosi; tumescentia etiam parva subelongata supra sinum posticum marginis inferi adest.

Color pronoti ferrugineus, incerte nebulosus.

Elytra modice elongata, albida, parum hyalina, venis venulisque omnibus atris, vel atro-piceis, vel piceis, crassiusculis, sub lente rugulosis et sub lente subtilissime etiam atro-piceo marginatis; ideoque more insolito et mirando elytra sunt atro-piceo reticulata. Latitudo maxima elytrorum circiter 12 mm; apex subrotundatus.

Alae subcycloideae, albido-subhyalinae; venis ferrugineo-fuscis; venulis latiusculis ferrugineo-fuscis, sub lente minute rugulosis et utrinque ferrugineo diluto subtilissime marginatis, series transversas vittarum angustarum ferrugineo-fuscarum, circiter 8, haud regularium, efficientibus.

Pedes cum corpore concolores, testaceo-fulvi, robusti. Tibiae 4 anticae superne ad apicem depressiusculae, subtus solito modo spinosae, spinis haud longis; femora intermedia crassiuscula, extus sulculis obliquis, subparallelis distinctis praedita. Femora postica basi crassa, ad apicem attenuata, parte attenuata etiam robustiuscula, subtus in dimidio apicali fere plana, spinis marginis externi 9—10, marginis interni usque ad 12, concoloribus, tantum apice fuscis. Tibiae posticae robustae, superne post basim planiusculae, spinis in utroque margine tantum 4 concoloribus, apice minime fuscis.

Abdomen cum reliquo corpore concolor. Ovipositor parum longus, levissime incurvus, ferrugineus, modice latus et modice robustus, apice attenuatus, valvulis apice haud acutis neque subtruncatis, sed vertice subrotundatis. Lamina subgenitalis ♀ trapezioidea subtriangularis, idest apice attenuata, ibique subtruncata et in medio leviter sinuata.

Cette espèce aussi est très-remarquable et très distinguée, et il paraît qu'elle n'a plus été retrouvée.

Gryllacris gracilis Walker.

♂ ♀. *Gryllacris gracilis* Walker 1869, Op. cit., p. 185—86. — Kirby 1906, Catal. cit., p. 141.

♀. *Gryllacris vittata* Brunner 1888, Monogr. der Stenopelmatiden und Gryllacriden, Verhandl. k. k. Zool. Bot. Gesellsch. Wien, Bd. 38, p. 334—35.

♂ ♀. *Gryllacris vittata* Bolivar 1899, Les Orthopt. de St. Joseph's College à Trichinopoly (Sud de l'Inde). — Annales Soc. Entom. France, LXVIII, p. 787.

♂ ? . *Gryllacris alternans* var. *minor* Brunner 1888, Monogr. cit., p. 333 (teste Kirby).

De cette espèce j'ai eu en communication une ♀ du Musée d'Oxford avec l'indication : „Cotypus“.

Elle doit être cependant absolument semblable au type de Walker; elle correspond bien à la description de Brunner et principalement à la variété plus pâle décrite par Bolivar.

En voici les principaux caractères :

♀. Longitudo corporis 22,5 mm, pronoti 5 mm, elytrorum 37 mm, latitudo maxima elytrorum 11,3 mm, longitudo femorum anticorum 7 mm, femorum posticorum 14 mm., ovipositoris 30 mm.

Corpus statura modica, longiusculum, haud robustum; colore testaceo-stramineo, vertice capitis et pronoto nigro variis, femoribus posticis subtus a medio usque ad apicem, apice excepto, atrocyaneis, hoc colore in lateribus extenso.

Caput ab antico visum ovatum-elongatum, angustiusculum; fastigium verticis articulo primo antennarum parum latius, marginibus lateralibus inferius tantum et parum argute carinulatis. Maculae ocellares fastigii verticis laterales, flavae, distinctae; macula ocellaris frontalis indistincta, verisimiliter subellyphica.

Vertex utrinque vitta laterali nigra a latere occipitis supra oculus ad maculam ocellarem perducta, irregulari, ornatus; his vittis anterieus inter se dilute coniunctis et in medio latis. Punctum nigrum parvum adest in angulis externis baseos clypei.

Pronotum a supero visum subquadratum, anterieus magis compressum, lobis lateralibus sat adpressis; margine antico in medio rotundatim parum producto, sulco antico valliforme et sulculo longitudinali abbreviato etiam valliforme bene expressis, sulco postico fere nullo; metazona leviter inaequali, levissime ascendente, margine postico subrotundato. Lobi laterales parum longiores quam altiores, postice multo quam antice altiores, margine infero obliquo, parte infera anguli postici truncati prominula, margine postico verticali alto, sinu humerali distincto; sulcus U-formis et sulcus posticus sat bene impressi.

Color pronoti testaceo-stramineus, vittis duabus longitudinalibus dorsalibus nigris a sulco antico ad sulcum posticum per-

ductis, antice posticeque dilatatis, posterius in ramum posticum sulci U-formis descendantibus, ideoque ipsis oblique V-formibus.

Elytra valde longa, modice lata, apice subacute rotundata, straminea fere hyalina, venis venulisque pallide testaceis, exceptis venulis campi antici distincte fuscis. Alae vitreae, elongato-subtriangulares, venis venulisque pallidis.

Pedes parum robusti, testacei. Tibiae anticae basi levissime rufatae, spinis solitis modice longis. Femora postica basi incrassata, ad apicem regulariter attenuata, subtus in utroque margine spinis 5—6 atris armata; vitta infera nigro-cyanea dimidia partis posticae horum femorum usque ad apicem extensa, excepto apice ipso, in utroque latere modice expansa. Tibiae posticae superne longiuscule post basim sensim planatae, spinis apice fuscis extus 6, intus 5.

Ovipositor longissimus, rectissimus, testaceo-ferrugineus, parum rigidus, angustiusculus, sub lente sat regulariter, rugulosus, apice subacuminatus. Lamina subgenitalis + transversa, sat parva, apice subrotundata.

Je confirme la synonymie sus-indiquée et déjà établie par Kirby, entre cette espèce et la *Gr. vittata* Brunner.

La *Gr. gracilis* Walker est une espèce indienne.

Gryllacris macrocera Walker.

♂. *Gryllacris macrocera* Walker 1869, Op. cit., p. 186—87. — Kirby 1906, Catal. cit., p. 146.

Typus Walkeri:

♂. *Statura minore sed corpore robustiusculo. Ferruginea, arcu verticis parum definito et maxima parte fastigii verticis nigro-fuscis, punctis duobus in parte infera frontis, macula parva sub utroque oculo et vittis brevibus undulatis ab angulo interno infero scrobum antennarum descendantibus, nigris, pronoto robustiusculo, inaequali, incertissime in sulcis quibusdam nigro signato; elytris testaceo-subhyalinis, in campo antico fere hyalinis, venis venulisque concoloribus; alis subhyalinis, venis venulisque pallidis; pedibus concoloribus; segmento dorsali ultimo utrinque appendicem inferam cerciformem intus versam gerente.*

Longitudo corporis 19,4 mm, pronoti 5,2 mm, elytrorum 17,5 mm, latitudo elytrorum 8 mm, longitudo femorum anticorum 6,5 mm, femorum posticorum 12 mm.

Habitat: Novae Hebrides.

Caput pronoto minime latius, ab antico visum regulariter ovoideum, robustiusculum. Occiput et vertex modice convexa; fastigium verticis latitudinem $1\frac{1}{2}$ primi articuli antennarum non attingens, anterieus minus convexum, lateribus obtuse rotundatis.

Maculae 3 ocellares solitae adsunt modice distinctae, flavo-testaceae, parum delimitatae; maculae verticis subovales, macula frontalis ovato-ellyptica, maior. Frons sat aequalis: sulci suboculares modice expressi, inferius lati. Clypeus et labrum elongatiuscula. Color capitis ferrugineus, facie lutescente. Arcus fuscus verticis supra et post utrumque oculum oriens, anterieus versus fastigium subacute angulatus, parum definitus, anterieus utrinque subtiliter interruptus. Fastigium verticis fuscum, in medio verticaliter subtiliter incerteque pallidum, supra (inter maculas ocellares) atro bimaculatum, maculis haud bene definitis. Fastigium frontis superne (in contiguitatem cum fastigio verticis) utrinque macula subtriangulari nigra praeditum, verticibus harum macularum intus versis. Ab angulo infero interno utriusque scrobi antennarii vitta atra angusta haud bene delimitata, sensim sinuata, descendit: his vittis sub macula ocellari leviter convergentibus, dein leviter divergentibus, subdilatis, et in medio frontis terminatis (dextra leviter longior, sinistra leviter brevior, sed subito sub ea punctulus niger adest). Pars infera frontis insuper utrinque punctum nigrum praebet. Sub utroque oculo, et cum oculo contigua, macula incerta fusco-nigra adest. Organa buccalia et antennae colore capitis.

Pronotum robustiusculum, a supero visum leviter longius quam latius, sat inaequale, lobis lateralibus sat adpressis. Margo anticus rotundatus; sulcus anticus valliformis latus, bene expressus; sulculus longitudinalis abbreviatus antice posticeque fossularis, postice latior; sulcus posticus expressus; metazona transverse convexa, non ascendens, margine postico truncato; gibbulae laterales externae subito ante metazonam optime expressae; gibbulae 2 parvae omnino laterales ante sulcum anticum etiam sat distinctae. Lobi laterales modice longiores quam altiores, postice altiores, margine infero obliquo recto, margine postico obliquo, sinu humerali non distincto; sulci soliti bene impressi, intervalli convexi.

Color pronoti ferrugineus nebulosus, maculis paucis parvis nigricantibus incertis, irregularibus, hic illic signatus, praesertim in sulculo abbreviato et in sulcis loborum lateralium.

Elytra femora postica perparum superantia, latiuscula, etiam apice sat lata, obtuse rotundata, pallide testacea, partim subhyalina, praecipue campo antico fere hyalino, campo postico basi magis testaceo, hoc colore etiam in medium versus apicem sat producto; venae et venulae testaceae pallidae. — Alae subcycloideae, hyalinae, leviter flavido-roseo tinctae, venis venulisque pallidis.

Pedes robusti, ferrugineo-lutei, concolores. Tibiae anticae solito modo spinosae, spinis longis. Femora postica basi crassa,

apice breviter attenuata, subtus in utroque margine spinulis 7—13 apice fuscis armata. Tibiae posticae superne post basim planatae, spinis utrinque 6 (raro 7) apice fuscis.

Abdomen ferrugineum. Segmentum dorsale octavum ♂ perparum plus quam septimum productum; segmentum nonum convexum cucullatum, margine apicali (inferius verso) utrinque sensim sinuato, in medio sensim rotundatim producto (sed parte media in typo haud bene conspicienda). In utroque latere extremo huius marginis appendix cerciformis articulado-inserta adest, angusta, elongata, subundulata, intus versa, concolor, teretiuscula, sub lente minute transverse sat regulariter oblique rugulosa, apice acuminata (circiter secundum typum *C*, Brunneri). Hae 2 appendices partibus intus versis superpositis, horizontalibus, omnino cum apice medio marginis postici segmenti noni contiguus. Cerci longiusculi, graciles, pilosi. Lamina subgenitalis ♂ sat magna, lateribus rotundatis, apice transverso in medio leviter angulato-sinuato, lobis late rotundatis. Styli robusti, modici, pilosi.

Espèce remarquable pour la structure des parties génitales externes du ♂; pour les autres caractères je crois qu'elle peut être placée près de la *Gr. ferruginea* Brunner. Il paraît que la *Gr. macrocera* Walker n'ait été plus indiquée par aucun auteur, même avec autre nom.

Gryllacris punctipennis Walker.

♂. *Gryllacris punctipennis* Walker 1869, Op. cit., p. 172. — Kirby 1906, Catal. cit., p. 145.

♂, ♀. *Gryllacris aurantiaca* Brunner 1888, Monogr. cit., p. 356. — Kirby 1906, Catal. cit., p. 145.

♂, ♀. *Gryllacris punctipennis* subsp. *Dempwolffi* Griffini 1909, Le Gryllacris papuane ad ali bicolori, Bollett. Laborat. Zoolog. Portici, Vol. III, p. 213—15.

Typus Walkeri:

♂ Longitudo corporis 31,7 mm (abdom: extenso), pronoti 7 mm, elytrorum 29 mm, femorum anticorum 10,8 mm, femorum posticorum 17,8 mm.

Ce type correspond très-bien à la description que j'ai donnée dans le travail sus-indiqué, lorsque ne connaissant pas le type et ne pouvant complètement reconnaître, par la description limitée de Walker, les caractères de cette espèce, j'ai décrit les exemplaires du Musée de Berlin sous le nom de subsp. *Dempwolffi*.

Je crois de pouvoir aussi, sans erreur, établir la synonymie sus-indiquée, entre la *Gr. punctipennis* Walk. et la *Gr. aurantiaca* Brunner.

Cette espèce donc aurait été jusqu'à présent trouvée dans les suivantes localités :

Batchian (type de Walker), Amboina, Insula Nova Britannia (Brunner), Nova Guinea, Archipelagus Bismarcki (Mus. Berolin.).

Les épines du bord extérieur des fémurs postérieurs peuvent atteindre le nombre de 9.

Gryllacris marginata Walker.

♀. *Gryllacris marginata* Walker 1869, Op. cit., p. 162. — Kirby 1906, Catal. cit., p. 142.

Typus Walkeri :

♀. *Apud Gr. heroem* Gerstaecker in *Systemate Brunneri locanda, sed etiam Gr. malayanae* Fritze ¹⁾ sat proxima. Robusta; ferrugineo-testacea subunicolor, summo apice femorum omnium anguste nigro-annulato, tibiis omnibus macula post-basali atra ornatiss, spinis tibiarum posticarum infuscatis et basi dilute fusco circumdatiss; fastigio verticis angusto; elytris testaceis, venis venulisque testaceo-ferrugineis; alis flavidis, basi infumatis, parte antica venis venulisque testaceis, ibique areolis submarginalibus partim infuscatis, campo postico maiori venis fusco-ferrugineis, venulis fuscis et utrinque late fusco marginatis, vittis fuscis distincte circumscriptis utrinque incerte angustaeque hyalino limbatis, versus marginem externum inter se partim coniunctis, ad marginem externum confluentibus, ideoque margine externo toto latissime fusco; ovipositore incurvo.

Longitudo corporis 31,5 mm, pronoti 7,9 mm, elytrorum 32 mm, latitudo maxima elytrorum 11 mm, longitudo femorum anticorum 12 mm, femorum posticorum 20,5 mm, ovipositoris 17,5 mm.

Habitat: Sarawak.

Corpus statura maiore, robustum, ferrugineo-testaceum modice nitidum.

Caput pronoto minime latius, ab antico visum regulariter ovoideum, sat robustum et subelongatum. Occiput et vertex regulariter convexa; fastigium verticis articuli primi antennarum latitudinem haud superans, fere subangustius, anterieus verticaliter concaviusculum et minute rugulosum, lateribus distincte tumidulo-carinulatis, tamen haud acute. Maculae 3 ocellares solitae flavidae adsunt parvae; maculae fastigii verticis subovales, macula frontalis valde angusta, lanceolata. Fastigium frontis superne in medio verticaliter impressum, ibique lateribus tumidulis. Frons

¹⁾ *Gr. malayana* Fritze in Carl 1908, Neue Locustod. von Ceylon u. Borneo, Mitth. Schweiz. Entom. Ges. Band XI, p. 305, Taf. VII, Fig. 11. — Griffini 1909, Studi sui Grillacridi del Museo di Oxford, Atti Soc. Ital. Scienze Natur., vol. XLVII, p. 315—316, fig. 1.

sub lente distincte punctata et transverse rugulosa, sat magna et longa. Sulci suboculares indistincti, inferius tantum latiusculi; organa buccalia solito modo confecta; palpi apice optime dilatati

Color capitis testaceo-ferrugineus. Punctum nigrum maiusculum adest in utroque scrobo antennarum, subito sub parte infera interna primi articuli antennae. Mandibulae intus et apice nigratae. Caeterum, organa buccalia, palpi et antennae cum reliquo capite concoloria.

Pronotum sat robustum et subinaequale, a supero visum subquadratum sed lobis lateralibus parum adpressis. Margo anticus in medio rotundato perparum prominulus, sub lente leviter punctulatus; sulcus anticus valliformis modicus, parum impressus; sulculus longitudinalis abbreviatus angustiusculus, forsam posterius fossularis, parum impressus; sulcus posticus parum expressus, tamen distinguendus; sulculi duo brevissimi obliqui ad latera sulculi abbreviati adsunt, anterieus divergentes. Gibbulae 2 parum prominulae (una utrinque) in parte antica sed sat longe post sulcum anticum adsunt, laeves; latera sulculi abbreviati tumidula; latera externa pronoti subito ante metazonam gibbulosa. Metazona transverse rugulosa, minime ascendens, margine postico truncato, levissime subrotundato. Lobi laterales longiores quam altiores, subtrapezoides, postice perparum altiores, margine infero recto, angulo postico rotundato subtruncato, margine postico sensim obliquo, sinu humerali minime expresso; sulci soliti bene impressi; sulcus late V-formis vertice infero subtruncato, a margine infero remoto; intervalli gibbulosi.

Color pronoti ferrugineus, lobis lateralibus leviter pallidioribus, testaceis; pars supera videtur incerte nebulosa; depressiones duo parvae, parum distinguendae, maculiformes, subito post gibbulas anticas dorsales videntur pallidiores.



Elytra modice longa et modice lata, sublanceolata, apice subacute rotundata, testaceo-ferruginea, in dimidio apicali campi postici parum minus colorata, venis venulisque ferrugineis.

Alae subcycloideae, tamen sat longae, flavo tinctae, basi fere usque ad primas venulas transversas infumatae. Pars antica angusta venis venulisque testaceo-ferrugineis, arcolis submarginalibus partim dilute infuscat, interdum maculam pallidam indefinitam includentibus; campus posticus venis ferrugineo-fuscis, venulis nigro-fuscis distinctissime et late utrinque fusco marginatis, vittis fuscis distincte circumscriptis, utrinque

incerte hyalino limbatis, vittas transversas valde irregulares in disco alarum circiter 4 efficientibus; versus marginem externum vittae reliquae fuscae inter se partim sunt coniunctae et ad marginem externum omnino confluentes, ideoque margo externus totus est latissime fuscus, a limbo extremo usque ultra tertiam venulam transversam.

Pedes longiusculi et validi, pubescentes, testacei. Apex femorum subtiliter atro annulatus; ima basis articularis tibiarum atra, dein basis ipsa pallida, inferius utrinque breviter diluteque infuscata: post basim tibiarum macula distincta atra irregularis superne adest. Tibiae anticae solito modo spinosae, spinis praecipue basalibus lateris interni longissimis. Femora postica basi modice incrassata, ad apicem sat longe attenuata sed semper robusta, subtus in utroque margine spinis 7—10 acutis, parum longis, apice fuscis, praedita. Tibiae posticae robustae, superne post basim planatae, ibique utrinque spinis 7 ferrugineo-fuscis, apice nigris, basi praecipue subtus dilute fusco circumdatis, instructae: apex harum tibiarum forsan incerte obscurior. Tarsi maiusculi.

Abdomen ferrugineum, superne in medio basim versus longitudinaliter indefinite castaneum. Segmentum dorsale ultimum ♀ sensim productum, apice transverso. Ovipositor ferrugineus nitidus, modice incurvus, rigidus, latiusculus, valvulis superne fere usque ad apicem sulcatis, apice superne suboblique truncato, vertice tamen sat acuto, parte basali apicis leviter dilatata, ideoque apex subtriangularis. Lamina subgenitalis ♀ elongato trapetiodea, apice sensim attenuata, ibi sinuata, lobis obtusis subtus tumescentibus. (Caeterum, pars infera abdominis in typo est laesa.)

Belle espèce, bien distinguée, placée par Mr. Kirby dans son Catalogue en un groupe tout différent probablement parceque Mr. Kirby n'en a pas vu le type. Cette espèce même par la structure des parties génitales externes de la ♀, présente les plus grandes affinités avec les autres espèces du groupe de la *signifera* Stoll.

Il paraît que aussi la *Gr. marginata* Walker n'ait été plus retrouvée.

OBSERVATIONS ON *EMPIS LIVIDA*, L.

BY A. H. HAMM.

Reprinted from "The Entomologist's Monthly Magazine," Second Series, Vol. xix.

It was with feelings of mingled surprise and delight that I read Mr. Milburn Howlett's most interesting account of the pairing of *Empis borealis*, which appeared in this Magazine for last October (vol. xliii, p. 229). The author here showed for the first time that the prey upon which the female feeds during the period of copulation is provided for her by the male. I there and then made a mental resolve to attempt to confirm the observation, and to witness for myself this extraordinary phenomenon: and my desire has been gratified beyond my expectations.

The following brief account of various observations extending from June 25th to July 7th inclusive will, I hope, speak for itself.

During an afternoon ramble on June 25th, while in search of *Diptera* and other insects, I came upon a spot by the roadside, about two miles from Islip, on the London Road between Islip and Wheatley, with a fairly broad grassy margin bounded by a high hedge, on which the herbage was very rank, the ground being of a slightly marshy nature. At this spot many individuals of *Empis livida* were seen resting on the leaves of various plants and grass stems. These

insects were entirely without prey, and I waited for some time in the hope that I might be rewarded later in the evening with some material to supplement Professor Poulton's recent paper on "Predaceous Insects and their Prey."* Just after 7 p.m. I saw the first male and female *in copula*, the female being in possession of prey; I then observed another pair hanging from a grass stem, the female also with prey. I continued to find fresh examples at intervals of a few minutes until six pairs *in cop.* had been captured, and in all of these the female was in possession of prey. It then occurred to me that if I abandoned the search for specimens *in cop.* I might perhaps witness the act of pairing. I accordingly fixed my attention upon the females, as far as I could see without prey, at rest on the herbage, &c. In a short time one of these females took to flight, and was almost immediately joined by several others. Together they slowly circled round and round in a kind of maypole dance, about three or four feet from the ground: so slow was their flight that ample opportunity for careful observation was afforded. After circling round a few times a male suddenly appeared among the dancers, having probably flown from the high hedge near by. He singled out a female and immediately gave chase. I then instantly netted the pair and found the prey which had been dropped into the net.

The remaining females then settled down again on the grass stems, &c. After a short interval the same scene was again enacted, and the pair netted before copulation had taken place. In this way four pairs were captured, and in every case the prey was dropped in the net. In two instances the flies which had been captured as prey were apparently uninjured and walked about the net. In another case as the male was chasing the female, and a few inches behind, I purposely interposed the net between them and captured the hindmost individual, and found as expected that it was a male with prey. After this four other males were seen to pursue females in the manner described above. These were watched very carefully to see, if possible, when and how the prey was transferred from one sex to the other. When the male overtook the female there was a brief struggle in the air; when this was over, the insects at once came to rest on the herbage, and were found to be paired. Only two or three seconds intervened between the time when the male overtook the female and the moment when they came to rest; so far as I could see the female was always in possession of the prey at the moment of alighting.

* Trans. Ent. Soc. Lond., 1906, p. 323.

Although I carefully examined every unpaired female seen at rest—and the number was considerable—in no instance did I find an example with prey.

The next observations were made on June 27th, when Mr. G. H. Grosvenor and I visited Bagley Wood, near Oxford. At 6.40 p.m. we came upon a very damp spot thickly overgrown with rushes (*Juncus*), on which were resting many individuals of this species. We decided to watch events, and soon found several pairs *in cop.*, some of which were captured; in all cases the female was noted to be in possession of the prey. In one instance we were able to watch the female squeezing the prey continually, probably the better to obtain the juices. We were not only enabled to confirm my previous observation of a day or two before, but to add a few details unnoted on that occasion. Those found at rest *in cop.* were closely observed, and it was seen that the male hung by its anterior pair of legs to the edge of a leaf or grass stem, supporting the whole weight of the female and her prey; the intermediate and posterior pairs of legs were tightly clasped round the female. A few males with prey were also seen settled upon the rushes, and these were carefully examined in order to ascertain the manner of holding the prey. From these observations we were perfectly satisfied that the prey was entirely free from the proboscis, being apparently held by the intermediate and posterior pairs of legs. In some cases, when the prey was rather large, an anterior leg would also be used for holding it, and the male Empid would then hang by one leg only. In one instance three males with prey were seen within a few inches of one another; one of these was boxed, and still retained its hold upon the prey for a minute or so after capture; another male with prey under observation rose to a female which was circling round quite close to it, and immediately paired in the air in the usual way. The insects were then netted as they were flying locked together. Another male, with a *Tortrix viridana* as prey, was seen to give chase to a female, and in my eagerness to secure the two I lost the female. We found no difficulty in distinguishing the sexes on the wing. The females fly very evenly and slowly round and round, while the flight of the male is more clumsy, due probably in some measure to the fact that he is burdened by the prey, which, when not too small, can be distinguished during flight; the male, furthermore, looks much browner than the female.

Further confirmation was afforded on June 29th when I visited "Mud Lane," just off the Cowley Road, Oxford; here, at 7.18 p.m., in a ditch bordering Lincoln College Cricket Ground, were found a

number of the same species. Six males were seen to give chase to females as they were circling round, and in each case both male and female were netted and the prey found in the net; in one instance the male retained possession of the prey, and walked up the side of the net still holding it. One pair was captured *in cop.*, the prey being in possession of the female; in another case two males were seen simultaneously to give chase to the same female. All three Empids were netted, and two insects captured as prey were found lying in the bottom of the net. On one occasion a male was observed to chase a female and to be repelled twice; at its third attempt the male was netted, and no prey was found in this instance.

Visits were also made to the last named locality on the evenings of June 30th, July 1st, 2nd, 4th, 6th and 7th, and on each occasion many observations were made almost identical with those narrated above.

The above observations entirely confirm Mr. Howlett's conclusions. The following interesting questions are raised:—(1) Does the male of *Empis livida* devour prey, and if so, to what extent compared with the female? (2) Does the female obtain food independently of that provided for her by the male, and if so, does she obtain it before as well as after pairing? (3) How does the male disable or kill the prey which he provides for the female? The facts here recorded show that the prey carried by the male is usually dead or motionless.

University Museum, Oxford:

July 9th, 1908.

OBSERVATIONS ON *EMPIS OPACA*, F.

BY A. H. HAMM.

Reprinted from "The Entomologist's Monthly Magazine," 2nd Series, Vol. xx.

Last year in making observations on *Empis livida* I also endeavoured to study other species of the same and allied genera. In this attempt I was unsuccessful, the weather being unfavourable or the season too far advanced. I have, therefore, been looking forward to this season in order to continue, if possible, the work begun last year. For several past week-ends I have sought unsuccessfully to find some of the earlier species. Yesterday (May 16th) I at last came upon a spot where this insect (*Empis opaca*) occurred in some abundance, along a rather high hedge bordered on either side by sandy fields, at Lye Hill, near Cowley, Oxford. At 11.20 a.m. I found a male with prey; it was carefully boxed, without disturbance, so that the manner of holding the victim might be studied. Through the glass-bottomed box it could be seen that the prey was held by the two intermediate legs, both anterior and posterior pairs and the proboscis also being quite free. I afterwards noted the same in other individuals seen at rest. Numbers of both sexes were observed sitting about upon the low herbage, but not one was seen to move; for a strong cold wind was blowing down the hill, making the conditions very unpleasant. After waiting some little time I moved off to try and find the species in a more sheltered place, but after more than an hour's fruitless search I returned to the original spot. It was now about 1 p.m. and the weather had improved, the sun being fairly bright. I soon saw that the Empids were now on the move, and at 1.5 p.m. had the satisfaction of witnessing a male (with prey) pair with a female. The actual pairing took place in the air, after

which they immediately settled down, the female being then in possession of the prey. As in *E. livida*, the male hangs by his two anterior legs to a leaf or grass-stem, supporting the whole weight of the female, with his intermediate legs tightly pressed to her thorax and his posterior pair clasping her abdomen. The female is all the time squeezing and kneading the prey, and every now and then thrusting her proboscis into a fresh place, apparently in order to extract all the juices from its body. Many pairings were witnessed, the male in every case providing the prey. In some minor details the habits of this species differ from those of *E. borealis* and *E. livida*, as recorded in this Magazine.* It differs more particularly from the latter species, in that instead of the females dancing together and so attracting the males, the males of *E. opaca*, always provided with prey, fly with a very rapid erratic zigzag flight over and about the low plants. They thus appear as it were to advertise themselves, and induce the females to take flight also. As soon as this happens the female is at once chased and pairing takes place as above described. So far as my observations go, copulation only occurs during sunshine, whereas in *E. livida* it is in the evening or late afternoon.

I kept the insects under continual observation from one until four o'clock, but at 3.15 p.m. the sun disappeared, and from that time onwards I did not see another individual of either sex on the wing, although there were scores settled about on the low herbage. I also failed to find even a male with prey. In the course of these observations, while closely watching a male and female *in copulâ* quietly settled upon a grass stem, I saw the male uncouple and fly away. At the same moment the female dropped the remains of her prey and flew away also. If this should prove to be the usual procedure, we can understand why the female is never at any time seen with prey except during the act of copulation. The observation at the same time supports the suggestion raised by Mr. Howlett in his admirable paper on *E. borealis*, that the provision of prey at this particular time is a physiological necessity for the proper performance of the act of copulation. If the prey be absolutely necessary to the female throughout the act, we can at once see why it should be invariably provided by the male. Professor Poulton has pointed out to me that if the prey is a physiological necessity for copulation, it by no means follows that it is of value as food. Its importance may depend upon incidental or correlated movements of limbs, or of internal structures. Through-

* Vol. xliii, p. 229, and Vol. xliv, p. 181.

out the whole course of my observations on this species, and more especially on *E. livida*, I have never yet seen a female in possession of prey except during copulation.

That the females of *E. opaca* feed like other flies is quite certain; for large numbers of them, and of the males also, were feeding half-buried in the flowers of the dandelion. *E. livida* can often be seen in numbers on bramble bloom, while *E. tessellata* and other species are often abundant on *Umbelliferae*.

In all some 40 individuals of both sexes with prey were captured: 34 of them were clasping various species of Bibios, 5 clasping each a different species belonging to various families of Diptera, while one had captured a male of its own species. In this respect *E. opaca* affords a marked contrast with *E. livida*, which preys upon almost all orders of Insecta, although it too chiefly attacks Diptera.

Precise details of all these captures will be dealt with by Prof. E. B. Poulton, F.R.S., in his next paper on "Predaceous Insects and their Prey."

My thanks are due to Prof. Poulton for much kind help and encouragement in making these observations, and to Mr. G. H. Verrall, for kindly confirming my determination of the species.

University Museum, Oxford :

May 17th, 1909.

FURTHER OBSERVATIONS ON THE *EMPINÆ*.

BY A. H. HAMM.

Reprinted from "The Entomologist's Monthly Magazine," 2nd Series, Vol. xx.

Empis opaca, F.—Since writing the account of this species in the June number of this Magazine (p. 132), I have been making further observations with a view to test the suggestion then made that the prey provided by the male is a physiological necessity. In a number of instances, the male having been seen to pair and settle down with the female in possession of the prey, a record was made of the time during which copulation lasted. The period was found to vary from a minimum of two-and-a-half to a maximum of five-and-a-half minutes, the average being about four minutes. The duration probably varied with the size of the victim, which was in my experience exclusively Dipterous. The male, after uncoupling, flew away, and the female

simultaneously dropped the prey, cleaned her proboscis and took flight. This was the usual procedure, but on four occasions the male after uncoupling, carried away the prey, which he helps the female to support with his posterior tarsi during copulation. In no case did the female ever retain the prey after the male had uncoupled. During the whole period of copulation the male moves his abdomen, more especially the posterior segments, backwards and forwards with a regular rhythm, this part of the body being alternately telescoped, and expanded for a small fraction of its length.

E. tessellata, F.—The following observations relating to this species were made at Lye Hill, near Cowley, Oxford, on May 23rd 29th, 30th, and June 5th, of the present year. On each occasion the species occurred in abundance, being like *E. opaca* most active during bright sunshine. I have seen them pairing as early as 10 a.m., and as late as 5 p.m. The males of *tessellata* fly much higher than those of *E. opaca* (often quite out of reach of the net); they also keep closer together, flying backwards and forwards very swiftly, frequently approaching and touching each other, as if testing for the presence of females, which when discovered are immediately chased by one or more males. The subsequent pairing and manner of holding female and prey being identical to that of *E. opaca*, it is unnecessary to repeat the details. After pairing they retired into the deep shade in the interior of the high hedge, so that the relative number found *in copulâ* is very small as compared with the number seen to pair. At 3.50 p.m., on May 29th, a male and female were observed to pair and settle down, the male, as usual, hanging by his two anterior legs to the edge of a leaf. They were at once enclosed, leaf and all, in a large glass-bottomed box, without the least disturbance; the box was placed in the shade and the insects watched during the entire period of copulation. The female, during the whole time, kept turning and twisting the Dipterous prey, and continually thrusting her proboscis into a fresh place. When the victim is examined with a lens the punctures made by the female Empid are clearly visible and are remarkable for the regularity with which they are disposed over the surface of the body. At 4.9 the male uncoupled, the female immediately dropping the prey. On several occasions the male was observed to capture the prey and afterwards disable it. The method adopted was as follows: the male sits in wait upon leaf or grass-stem, darting upon any fly coming near enough. If successful he immediately proceeds to hang by the tarsal claw of one of the anterior legs, to the edge of a leaf or twig, &c., the other five legs being tightly

clasped round the struggling victim. He then proceeds to feel with the tip of the proboscis over the thorax of the fly, finally reaching and immediately piercing the junction between head and thorax. The proboscis was withdrawn after a few seconds, the victim being apparently paralyzed and only showing slight movements of the body or limbs. Several males were boxed directly after they had begun to hang by one leg. In all such cases the intended victim was quite uninjured, both Empid and fly being equally lively. These observations seem to point to the conclusion that it is the central nervous system that is acted upon, and an effect produced similar to that wrought by the sting of a fossorial wasp upon its prey. Additional support is also lent to this view by the perfect and uninjured condition of the victims held by the males. In the very large number captured and examined no trace of any puncture of thorax or other part could be detected. This species like *opaca* confines its attention exclusively to *Diptera*.

E. trigramma, Mg.—I thought at one time that all the species in this genus might exhibit habits similar to those already recorded. Careful observation, has, however, proved that *E. trigramma* at all events is an exception; for the prey captured by this species is devoured independently of copulation. The male and female *trigramma* without prey go through a rather elaborate form of courtship prior to pairing—most interesting to watch, but difficult to describe—the following observations were made during May and June, at Lye Hill. On June 5th at 6.48 p.m., I was looking at a female *trigramma* resting on an alder leaf, when a male alighted about an inch distant from her, fluttered his wings for a few seconds, then raised his anterior legs and waved them about. The female then fluttered her wings and raised her anterior legs and moved them about also, apparently in response. The male then rubbed the anterior tarsi together for some seconds moving them quickly and at the same time rapidly vibrating his wings, which were maintained in a horizontal position. These actions were repeated with variations by one or the other for the space of three minutes. The pair had now drawn closer so that each was able to touch the other's anterior tarsi in a caressing manner. This they continually did, the male every now and then rapidly vibrating his wings. These actions continued for over two minutes, when the female slightly raised the apex of her abdomen, the male gently flew on to her back, and pairing took place immediately. The total time occupied in courtship was, therefore, about five-and-a-half minutes. The leaf with the pair *in copulâ* was

carefully detached, laid down, and without disturbance covered by a large glass-bottomed box, under which the insects remained paired for just over six minutes. On May 29th, at 4.35 p.m., a pair was seen going through exactly the same actions as those previously observed during the latter half of the courtship. The insects paired in less than two minutes, and it is evident that courtship was partly over when observation began. Again, at 6.46 p.m., a third pair were seen going through the latter phases of courtship, but in this case the male did not succeed in pairing. On the same dates and place six females were taken, each feeding on a small Dipteron. On May 22nd, at 2.15 p.m., near Enslow, I boxed a male that was eating a small Dipteron. During the earlier part of the day numbers were observed feeding on the hawthorn blossom and flower-heads of *Umbelliferae*.

E. punctata, Mg.—During the present summer, at Lye Hill, I have taken this species *in copulâ* without prey, and also an unpaired female eating a small Dipteron. It is highly probable that the habits of this species will be found to be similar to those of its close ally, *E. trigramma*.

E. scutellata, Curt.—Five pairs of this species—in all cases without prey—have been taken *in copulâ* at Lye Hill, on various dates during May and June. During copulation the female hangs (usually from a grass-stem), and supports the male. Her wings are held horizontally, and at right angles to the body, while the anterior legs of the male are raised, after the manner of *Anopheles*.

Pachymeria femorata, F.—This species was first noticed on May 30th last year, in a disused quarry close to Bletchington Station. I then observed a number of *Diptera* flying together in the sun under the boughs of a small larch. As they seemed strange in appearance, I made a sweep with the net and captured a number, and, to my surprise, found that they were all males of *P. femorata*, and that each had been carrying a fly. The latter were lying in the bottom of the net. By repeated strokes some 50 males were captured (a few having escaped from the net). The prey consisted of 50 Bibios and 10 examples of other *Diptera*. No further observations were made at the time, as I had then no thought of studying the manner of pairing, and only took the specimens in order to aid Prof. Poulton in his researches on "Predaceous Insects and their Prey." In the meantime the observations on other Empids induced me to pay special attention to their habits of pairing.

On May 20th last I again saw *Pachymeria* in the University Parks, close to and eastward of the Museum, behaving exactly as I had seen

them in the previous year. They were seen by me and Prof. Poulton, to whom I showed them, flying in small companies in the sun, but always under the shelter of a bush or overhanging bough, and every one was carrying prey. A number were captured, and with one exception all the examples proved to be males carrying prey. The single exception, netted because it appeared to be carrying something much larger than usual, proved on examination to be a male, female, and prey. As the public walks in "The Parks" are not ideal places for prolonged observation, I decided to visit Bletchington again. When I arrived on the ground, about 3 p.m. on May 22nd, I found *Pachymeria* in the greatest abundance, every bush or tree having its company. The insects were always seen on the sunny side, so that the bush or tree afforded a dark background. Selecting a small larch for observation, I found that the *Pachymerias* could be observed to the best advantage by keeping in the shadow and looking out towards the light. They fly at a fairly uniform height (which varies according to the particular bush or tree), keeping well together and moving or "dancing" in a more or less horizontal plane. In the course of the flight they continually approach and even touch one another. Females, apparently desirous of pairing, joined in the dance, and as soon as one of these was discovered one or more males at once gave chase. They were seen to link together in the air, and soar away to the higher bushes or trees, always well out of reach of the net. Such pairings were seen again and again, but owing to the soaring habit none were actually netted *in coitu*. At a later date, however, at Lye Hill, two pairs were taken *in copulâ*, the female in each case having the prey. The method of resting is quite different from that of the genus *Empis*, for the female clasps both the twig and the prey, and also carries the male. Many males were boxed with prey as they rested upon twigs, &c., clasping the victim by their intermediate legs and posterior femora, and the twig with anterior and posterior tarsi. In nearly all cases the prey was carried with its dorsal surface downwards, the pendent wings being very conspicuous. In all cases the victim proved to be Dipterous, and was nearly always as large as, or even larger than the *Pachymeria*.

I have observed these insects at many times and in many localities around Oxford during the present summer, and they were invariably flying and acting in the manner described above. Like some of the other Empids they are very dependent on bright sunshine. Under favourable conditions they may begin their "dancing" as early as 9 a.m., and continue as late as 6 p.m.

Rhamphomyia sulcata, Fln.—A pair of this species was taken in

copulā at Lye Hill on May 23rd, the female being in possession of prey. The male was hanging by his two anterior legs to a twig, supporting both female and prey. The habits of this species, so far as they have been observed, are therefore similar to those of *E. livida*, *opaca*, &c., and they may eventually prove to be identical in other respects.

My thanks are again due to Prof. E. B. Poulton, F.R.S., and Mr. G. H. Verrall, F.E.S., for their kind assistance.

University Museum, Oxford :

June 7th, 1909.

SETULIA GRISEA, MG., AND CERCERIS ARENARIA, LINN.,
IN THE NEW FOREST.

BY A. H. HAMM.

Reprinted from "The Entomologist's Monthly Magazine," 2nd Series, Vol. XX.

On August 7th last I joined my friend, Mr. G. Arnold, for a few days entomologizing together, at Brockenhurst. I am indebted to him for kindly pointing out the nidificating sites of many interesting species of Fossorial Wasps, and in other ways conducing to my comfort and enjoyment, both on this and previous visits to the Forest.

Our first excursion (August 8th) was to the ground near the southern end of Denny Bog. Here we were soon busily engaged in watching the burrows of various species of Fossores, our object being to ascertain the kind of prey that was stored for the future progeny. I was thus engaged when my friend, who had been prospecting a little further afield, returned and reported the discovery of a large colony of *Cerceris arenaria*, a species I expressly wished to find. While watching the burrows we noticed a fly, somewhat like a *Miltogramma*, persistently following a female *Cerceris* returning to the burrows with her weevil prey. We felt sure that the Fossor was aware of the pursuit, and that she endeavoured to some extent to shake off her enemy, for, instead of flying direct to the burrow, she often dodged or zigzagged about, or settled upon the ground. These tactics were of no avail, for the fly followed all the

meanderings with perfect ease, always keeping at a distance of about three or four inches behind. This we saw many times repeated, and always with the same result. The observations were continued with a view of ascertaining the further actions of the fly. It was found that when the *Cerceris* entered the burrow with her prey, the fly immediately settled close by the hole and remained perfectly motionless—often for as long as five or six minutes—facing the orifice. When finally the Fossor departed in quest of further prey, the fly entered the burrow, probably in order to oviposit, re-appearing again in less than a minute. Although males of *Cerceris arenaria* were flying about the burrows, in no case did we observe that the fly followed them: only the females with prey were pursued, sometimes by two and in one instance by three of the Dipteron.

The seven individuals mentioned by Mr. Colbran J. Wainwright were the specimens actually captured following the *Cerceris* with prey, and in each case fly, Fossor and prey were taken with a single stroke of the net. Many others were seen, and some captured as they sat upon the bare sandy ground.

On August 10th we found another and much smaller colony of *Cerceris arenaria*, near Matley Bog, when we again observed the fly behaving exactly as on the former occasion.

My sincere thanks are due to Mr. Colbran J. Wainwright for kindly identifying and writing the following account of *Setulia grisea*, Mg. Examples of specimens described by him may be seen by entomologists in the Hope Department, Oxford University Museum.

University Museum, Oxford :

November, 1909.

SETULIA GRISEA, MG., A TACHINID NEW TO BRITAIN, AND
ITS ALLIES.

BY COLBRAN J. WAINWRIGHT, F.E.S.

Reprinted from "The Entomologist's Monthly Magazine," Second Series, Vol. xx.

Mr. Hamm, who wished to publish an account of some observations he had made on the habits of this species, requested me to add a short description of it; which I was the more willing to do, as I felt a slight doubt as to the correct name for it, and thought it advisable to make it clear what species is being referred to.

Setulia grisea, Mg., is a very near ally of *Miltogramma punctatum*, Mg., a well-known and common British species. They have similar habits, both haunt *Hymenoptera*, and bear a strong general resemblance, and might even be mixed in collections. There are two other known British allies, *Miltogramma germari*, Mg., and *Sphecapata conica*, Fall., all haunting *Hymenoptera*, and bearing an obvious family likeness. Wherever one finds a sandy spot with the burrows of Aculeates, there one will almost certainly find one or more of these species, settled on the bare hot sand waiting for their hosts, or following them to their burrows; flying about with a feeble flight or settled on the flowers of the ragwort near by; but while *M. punctatum* and *S. conica* are common and have often been taken in such places, the other two species are at present little known, though I anticipate that they will prove to be commoner than our experience to date has led us to believe. Mr. Malloch recorded *M. germari* for the first time in Ent. Mo. Mag., 1909, p. 105, the specimens having been taken by Mr. Hamm, near Oxford: and I took one in the New Forest, near Lyndhurst, on August 5th last; and now Mr. Hamm records *S. grisea*, and curiously I also took one near New Milton, Hants, on August 4th this year about the same date as that on which his were taken.

The four species may be roughly separated as follows:—

- A. Species with well developed setæ on the facial angles, one pair of bristles being large and strong and crossed as in most *Tachinidæ*.
 - I. Black palpi and antennæ *conica*, Fall.
 - II. Yellow palpi and basal joint at least of antennæ..... *grisea*, Meig.

B. Species with the facial angles occupied by a few weak hair-like bristles, no one pair larger than the others.

- I. Basal antennal joints yellow, abdomen without spots.....*germari*, Mg.
- II. " " " black, or at most with a little yellow between the 2nd and 3rd joints, abdomen distinctly spotted.....*punctatum*, Mg.

Sphecapata conica, teste Brauer, should have bare cheeks; all ours I believe have some bristle-like hairs on the cheeks, and, therefore, also teste Brauer, would work out to *Arrhenopus piligena*, Rond.: Mr. Verrall I know inclines to believe the names synonymous, and that the presence or absence of the hairs is not of specific importance. The species is the smallest of the lot and is paler and greyer and unmistakeable at a glance: it seems specially associated with *Oxybelus uniglumis*, F.

The two *Miltogrammas* are very closely allied; but *punctatum*, especially when looked at from in front always has distinct spots on the hind margins of the segments, while *germari*, which has none, on the other hand shows marked tessellations, or alternations of light and dark reflections: *germari* too has distinctly yellow basal antennal joints and in the male has simple fore tarsi, whereas, *punctatum* has some strongly developed hook-like hairs which look like long claws, and which probably serve instead of the true claws which are very small. *M. punctatum* seems most common round the burrows of bees of the genus *Colletes*.

Setulia grisea (teste Brauer again) should have scattered hairs on the cheeks; that is to say the genus (*Metopodia*, Brauer calls it), is so characterised; but I carefully examined all Mr. Hamm's seven specimens for these hairs and even under the microscope could only think I saw a few; my one specimen on the other hand shows a number of distinct but pale down-like hairs, by no means answering to the description "scattered"; moreover, none of the descriptions published of *grisea*, Mg., mention the, as I think, characteristic, abdominal markings, which, however, are certainly variable: the most conspicuous feature is a dark central line which is broken up into a pair of long spots on each segment, these spots not always reaching the fore margin of the segments; then there is usually another spot on the hind margin of each segment at each side, and these are occasionally lengthened nearly to the fore margins. The whole insect is yellower in appearance than either of its allies, its frontal streak not much yellower than the rest of the face. It is smaller on the average than *M. punctatum*, but the largest specimens are as big

as ordinary sized *punctatum*; of the eight I have examined the length varies from 5 mm. to $7\frac{1}{2}$ mm., thus somewhat exceeding the measurements quoted by Schiner and others. In spite of the apparent disagreements I have little doubt in my own mind that I have correctly identified the species; it should be readily recognised by the characters given, though it may be found mixed up with *M. punctatum*, which it resembles in practically all those characters not referred to above. All the eight specimens are ♀ ♀.*

45, Handsworth Wood Road,

Handsworth, Staffs.:

November 7th, 1909.

Sitaris muralis, Forst., n. var. *flava*.—During the last three years (1907—9) I have each season taken a few quite mature specimens of *Sitaris muralis* differing from typical examples, in that the whole of the elytra, wing membrane and abdomen are clear yellow instead of black. I therefore propose for this apparently hitherto unrecorded variety the name *flava*. All the specimens of this form have occurred in the neighbourhood of one village about two miles S. E. of Oxford, and, with a single exception, on one and the same wall ♂ and ♀ types are deposited in the Hope Department, Oxford University Museum —A. H. HAMM, Oxford: November, 1909.

* Since writing the above, through the kindness of Dr. Villeneuve, I have had an opportunity of submitting my specimen of *Setulia grisea* to him, and he has confirmed my identification.

SOME NOTES ON THE *LEPIDOPTERA*
OF THE "DALE COLLECTION" OF BRITISH
INSECTS,
NOW IN THE OXFORD UNIVERSITY MUSEUM.

BY

JAMES J. WALKER, M.A., R.N., F.L.S.

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I.—RHOPALOCERA.

In the history of British Entomology during the second quarter of the nineteenth century, three names—those of James Francis Stephens, John Curtis, and James Charles Dale—stand pre-eminent; and the great collections of all Orders of our indigenous insects, formed by these pioneers of our Science, fortunately still exist in their entirety. One of these, that of John Curtis, is now at the Antipodes, and thus no longer within our reach, but Stephens's insects have long formed a valuable item in our National Collection; and within the last few months, the extensive collections commenced by the elder Dale in the opening years of the last century, and since his decease in 1872, continued and augmented by his son, have through the munificence of the last-named Entomologist, found a final and per-

manent resting-place, in which they will be accessible for study and examination by all workers who may desire to consult them. Under the will of the late Charles William Dale, the whole of the collections, as well as the entomological diaries and other records made by his father and himself, are bequeathed to the Delegates of the University Museum at Oxford, subject to the condition that they shall be permanently kept separate under the name of the "Dale Collections."

The value of this generous bequest can scarcely be over-estimated, as besides the personal and historical interest attached to very many of the specimens, some of which have been handed down from Haworth's and other classic collections, and the number of rare and now extinct British species, and of fine and remarkable varieties which they include, these collections formed the source whence Curtis derived a great part of the material used in his splendidly illustrated "British Entomology." They thus contain many of Curtis's "types;" and others of his species, which may be more or less open to doubt, may be verified by reference to the Dalean collections. The journals and records, which are continuously carried on from 1808—the first definite date in J. C. Dale's "Entomological Calendar," May 2nd, 1808, recording the capture of "*Pontia cardamines*" at Enborne, Berks—nearly up to the time of C. W. Dale's death early last year, form an entomological narrative of very great interest and value. The above-named MS. volume, indeed, takes us even further back in time, as Dale's "Calendar" is preceded by one on the same lines, compiled by him from the notes of the Rev. Charles Abbot, D.D., F.L.S., one of the Masters of Bedford Grammar School, in which the earliest entry bears date May 8th, 1798. Thus we have considerably over a hundred years of continuous entomological records embodied in these volumes, in which the date and other particulars of the capture, &c., of nearly every specimen in the collections has been entered, and the exact history, of at least every important insect, could be traced by its original possessors. It is, however, much to be regretted that, at any rate in the case of *Macro-Lepidoptera*, a large number of specimens bear no label of any kind, and thus they cannot be connected with the records with any degree of certainty.

Complete summaries of the species represented in the collections were drawn up by C. W. Dale after the death of his father, a separate volume being devoted to each of the larger Orders; the particulars relating to the *Lepidoptera* being entered in a copy of "The Lepi-

dopterist's Register, compiled by T. J. Carrington." This has proved of great service to me in preparing the following notes on the *Macro-Lepidoptera*, a task which I have undertaken at the suggestion of my friend Prof. E. B. Poulton, F.R.S., who now has the Dale Collections under his care. I have also found the two works by C. W. Dale "The History of Glanvilles Wootton, including its Zoology and Botany" (London, 1878) and "The History of our British Butterflies" (London, John Kempster and Co., 1900) of considerable assistance.

In these notes I have adhered to the nomenclature and sequence under which the insects now stand in the collection, and under which they will remain; but these names, if perhaps hardly "up to date," will at any rate be familiar to Entomologists. The abbreviations "J. C. D." and "C. W. D." refer to the labels attached to the specimens, in the handwriting of James Charles Dale and Charles William Dale respectively, though it must be said that in the case of the latter the MS. is not always very legible.

The *Rhopalocera*, as finally arranged by C. W. Dale, are represented by 1944 specimens, occupying 16 drawers in a 24-drawer cabinet of modern make, and include:—

Papilio podalirius, L.—One specimen in somewhat poor condition, without antennæ, but with the tails perfect. The label attached to the insect is as follows: "Clapham Park, wood, May, 1803? nr. Bedford. Dr. Abbot? Mus. Dr. Abbot" (J. C. D.). This corresponds with the entry in Dr. Abbot's "Entomological Calendar" as to the capture of this very doubtful British species in that locality.

P. machaon, L.—A series of 21 specimens, including specimens labelled, "Whittlesea Mere, Hunts., Aug. 7, 1820. B. Standish." "Larva found at Bardolph Fen, Norfolk, July 28th, 1819, turned to fly July 4, 1820, J. C. Dale." "Whittlesea Mere, Hunts., July 24, 1819, J. C. Dale." A fine, large, rather light-coloured ♀ is labelled, "Newlands Common, Glanvilles Wootton, Dorset, Aug. 17, 1815, J. C. Dale," and appears to be the last specimen taken in that locality, where it had previously occurred not rarely. Two examples, "Whittlesea Mere, 1821" (C. W. D.). A curious variety of the ♂, normal, except the right fore-wing, which is much bleached, the ground colour being of a pale dull ochreous tint, and the usual black markings replaced by light brownish-grey. "Bred by Mr. S. Fortesque, of Worcester Park, 1839. Larva from Wicken Fen." (J. C. D.). Three examples in moderate to poor condition, in two of which the yellow colour is greatly darkened, apparently by age, while the third and best may possibly be a dark variety. This has a label, "1893, Cooke, E. Coll., Pritchard, Reigate;" and another, "The whole 3 are specimens given me by C. R. Briggs" (C. W. D.).

Aporia crataegi, L.—A series of eleven good specimens, the first, on an enormous common pin, is labelled at side, "May, 1808, Glanvilles Wootton" (C. W. D.), another, "June 18, 1815, Glanvilles Wootton." There are also specimens from Herne Bay (one very small), the New Forest, Hereford, and Bridgend.

Pieris brassicæ, L.—Nine examples of the var. *chariclea*, Steph.

P. rapæ, L.—2 ♂s, exceedingly small; 3 ♂s, nearly immaculate, one entirely so; several very deeply cream-coloured ♀s, and one ♀ (Glanvilles Wootton, Oct., 1870) very broadly suffused with dark grey at the base of all the wings.

P. napi, L.—A varied series, including some fine dark Irish and Scotch specimens; 2 ♀s with all the markings exceedingly faint, and one small and well-marked ♀, with the left fore-wing rounded at the apex, so as to give the hind-margin a regularly semicircular outline.

P. daplidice, L.—Thirteen specimens stand under this name, of which, however, the first two are unquestionably ♂ examples of the South European *Euchloë belia*, F. The first of these, on a modern English gilt pin, has no label; the second is labelled "From J. G. Ross collection 1882, Brighton" (C. W. D.). A very aged and shabby-looking ♀ example of *P. daplidice* is of peculiar interest, as it is possibly the oldest specimen extant of this, or of any British butterfly. The label, in C. W. Dale's handwriting, reads on one side "Given to Rev. Henry Burney by J. C. Dale, bought at his sale 1893 by C. W. Dale." On the other side "Bought of Latham, one of Petiver's, probably taken at Gamlingay." At the side is a printed label "1702, Cambridge." (Petiver's folio work "*Papilionum Britanniae Icones Nomina, &c.*," in which *P. daplidice* is figured, bears date 1717, and he died in the following year, so if the specimen be really one of his, the date is probably correct). A faded ♂, under-side, is labelled "Mus. Dr. Abbot, White Wood, Gamlingay, Camb. June 1803, Dr. Abbot" (J. C. D.), and another very aged-looking ♂ example "From R. Hinde of York. Taken at Dover." Five other examples hail from Dover, among them one fine ♀ (under-side) "Bred at Dover, Aug. 2, 1835," and another "Dover, Aug. 1835, A. Leplaisrier," one from Folkestone, one "Taken by a poor boy at Margate in 1859," and one ♂ "Taken at St. Leonards in 1859, brought to Kent, the birdstuffer, from whom obtained."

Anthocharis cardamines, L.—Several very small ♂; one or two of this sex with the central black spot in the fore-wing evanescent, and one in which it is quite absent. One remarkable ♀, with an orange dash along the costa, and another in the dark apex of the right fore-wing. This is labelled "G. Baker, Burton-on-Trent," and was obtained by Mr. C. W. Dale in 1905 at the dispersal of the collection of the late Dr. P. B. Mason.

Leucophasia sinapis, L.—The series includes several specimens from Glanvilles Wootton, three quite immaculate examples from the New Forest, labelled at side "v. ♀ *erysimi*, Bdv.," and three labelled "v. *diniensis*, Boisd."

Gonepteryx rhamni, L.—Some deeply coloured ♀s, and one example apparently of this sex, broadly and irregularly suffused with orange-red at the margins of the fore-wings, and of the left hind-wing. This has, however, an unconvincing appearance, and suggests a "cyanide bottle" variety. It is labelled at the side "Wareham, 1902."

Colias edusa, L.—A very fine series of the ordinary form, and of var. *helice*, with three fine intermediate lemon-coloured forms. One of the *helice* has the dark border immaculate "From J. G. Ross coll., 1879" (C. W. D.). Three dwarf examples (2 ♂, 1 ♀, the latter with very dark border), resembling specimens of the late autumn brood which sometimes occurs here, are labelled "*Chrysothème*, Steph., Dover," and agree well with the figure of that form in Ill. Haust. I, pl. II, figs. 1, 2.

Colias hyale, L.—Thirteen examples, but no noteworthy variations.

Arge galathea, L.—One ♂, with the ground-colour rather dark ochreous-yellow, perhaps due to age; one very dark example, corresponding closely with the South European var. *procida*, Hubn., on a large common black pin, labelled "From J. G. Ross, 1879" (C. W. D.). (There is a similar specimen, ex coll. Spilsbury, in the fine collection of British butterflies in the Oxford University Museum). An exceedingly beautiful and striking variety of the ♂, in fine condition; the fore-wings above being entirely deep black, except for the large basal and inner-marginal white spots, which are nearly normal, and the submarginal spots, which are much reduced. The basal spot and submarginal spots of the hind-wings differ but little from those of the ordinary form, but the broad central white band is obliterated to the middle of the wing by the black ground-colour, and its inner marginal portion is much suffused with black scales. The under-side of both wings is also strongly suffused with dark grey, except on the hind-margins, all the usual markings being smudged and nearly obliterated, and the ocelli on the hind-wings fairly distinct. Of this fine variety, which bears the label, "Dover, by Le Plaistrier, figured in Loudon's Mag. 1832" (C. W. D.), there is a brief description by the Rev. W. T. Bree, as well as a beautiful and accurate woodcut representing the upper and under-sides, in "London's Magazine of Natural History," vol. V, p. 335, fig 73 (1832).

Satyrus semele, L.—A fine and varied series of 42 examples, including one ♂ with no trace of the usual ocelli on either side, except a minute black dot at the apex of the fore-wings beneath; four very brightly-marked specimens, one ♀ especially so, approaching the S. European form *aristæus*, Bon., "Derry, 1889, Curzon." Some pale but well-marked examples from Rannoch, and several under-sides from Cornwall (Bude and the Lizard), very like the finely-marked form found in the West of Ireland.

Satyrus ægeria, L.—One ♂ with the dark brown ground colour replaced by a rather pale sepia shade; one ♂ in poor condition, almost without markings above, "Goodman Sale, Stevens, 25 Nov., 1890" (C. W. D.), and a nearly similar ♂ example, but in better condition, "P. Bouchard, 1860" (C. W. D.).

Satyrus megæra, L.—Some very pale ♀ specimens, one from "Rev. F. O. Morris, Charmouth, July, 1831," and another labelled at side "var. *lyssa*, Bdv." (C. W. D.), and bearing a label "near Sandsfoot Castle, Aug., 1836, A. Pretor." This remarkable variety is above almost exactly like a small ♀ of *Pararge mæra* var. *adrasta*, Hb; the under-side is that of rather pale but otherwise typical *megæra*.

Satyrus hyperanthus, L.—Six fine examples of the ab. *arete*, O., one of these from "Glanvilles Wootton, July, 1895" (C. W. D.), and two of the fine ♀ variety with the ocelli beneath enlarged and elongated (var. *lanceolata*, Shipp), labelled "Middlemarsh, Aug. 5th, 1816" (C. W. D.). Mr. C. W. Dale's register shows this specimen to have been taken by his father.

Satyrus janira, L.—An exceptionally fine series of varieties and aberrations, of which the following may be noted:

One ♂, almost uniform pale warm brown above, the sexual brand on fore-wings slightly darker, and the apical ocellus indicated on both sides by a white-pupilled light greyish-brown spot; the under-side of hind-wings pale fawn-colour. Labelled

"Newport, 1861." One ♂, similar to the preceding, but brighter and richer in colour, clear fawn or cinnamon-brown on both sides, with slightly darker sexual brand and apical ocellus. "Glanvilles Wootton, C. W. Dale, 1864" (C. W. D.), and at side "June 22, 1864." An old specimen of this form from Dover. Two fine ♂♂, rather pale brown above, with large symmetrical whitish blotches in fore and hind-wings, one having a dark transverse bar in the pale centre of the left fore-wing; this is labelled "Glanvilles Wootton, C. W. Dale, 1864" (C. W. D.), and dated June 2nd, 1864. Four ♂♂, unsymmetrically blotched with whitish-brown or bone-colour, and a ♂ from the Isle of Harris, having the fore-wings almost entirely dark-brown beneath. A ♀ from the same locality is very dark and rich-looking, the fulvous suffusion in fore-wings being singularly deep in tone. Of this sex, the finest variety is one entirely pale fawn-colour above, with the central fulvous blotch nearly normal. "C. Blomer, 1857" (C. W. D.), and at side, "Dartmoor." Another ♀ is normal except the right fore-wing, which is entirely pale whitish-brown or bone-colour, the apical ocellus just visible as a faintly darker shade, "Glanvilles Wootton, C. W. Dale, 1874"; and one "From Briggs coll., 1896 (C. W. D.), has in each fore-wing a large suffused pale fulvous blotch enclosing an elongate whitish spot below the cell, and the hind-wings largely and symmetrically suffused with whitish-brown above and below. Nearly all these fine varieties are in good condition.

Satyrus tilhonus, L.—Two of each sex, with well-marked supplementary black spots in fore-wings, and in one, "Teignmouth," the lowermost spot is white-centred. A ♂ with the left fore-wing completely bleached except at the base, and a very fine ♀ aberration, in which the fulvous colour is replaced by bone-white, "From Rev. H. Burney's coll., 1893" (C. W. D.).

Chortobius pamphilus, L.—One ♂ strongly tinged with purplish-brown, and a beautiful example of the same sex, with the ground-colour clear pale ochreous-yellow without any fulvous tint, the margins cool grey, and the apical spot very dark and conspicuous. Labelled at side, "Langport." Two or three specimens with the ground-colour partially bleached, and others with the dark margins obsolete.

Erebia medea, W. V.—A fine series, but only one marked aberration, a very light-coloured ♀, "Forres, Salvage, 1890" (C. W. D.).

Erebia epiphron, Knoch.—Also well represented by series from Westmoreland and Perthshire, and including a very fine variety of the ♂, deep sooty or umber-brown on both surfaces, with no trace of fulvous anywhere, but with the ocelli of the fore-wings represented by black spots in elliptical pale greyish rings. "J. G. Ross, 1880" (C. W. D.).

Chortobius davus, F.—A very fine series of 66 examples, exhibiting the great range of variation for which this species is so remarkable, and including examples from North Wales, Cheshire, Lancashire, Yorkshire, Newcastle, Cumberland, Killybeg, Armagh, and Orkney.

Apatura iris, L.—A series of 23 specimens, some of which were taken by J. C. Dale at Enborne, Berks, in the early years of last century. A very fine ♂ var. *iote*, Schiff, in which, however, the right hind-wing is somewhat abbreviated. "From J. G. Ross coll., 1879" (C. W. D.), and a ♀ in fine order, in which the ground-colour is quite a light sepia-brown.

Limenitis sibylla, L.—A very fine example, with the usual white bands faintly indicated by a few suffused grey blotches, "J. G. Ross coll., 1879" (C. W. D.), and another under-side of the same form, not so fine, "N. Forest, 1897." Both these are labelled at side "*v. oblitteræ*."

Vanessa cardui, L.—An exceedingly fine variety, in markings corresponding almost exactly with the lower figure "Painted Lady, var. 1," on page 64 of Newman's "British Butterflies"; indeed, the specimen may well be the identical one, formerly belonging to Mr. Ingall, from which the figure was drawn. It is on a rather ancient pin, but is in excellent condition, and is labelled "S. Stevens coll., 1900" (C. W. D.), and at the side, "New Forest."

Vanessa huntara, F.—A small and dull-looking specimen, in rather poor condition, of this well-known North American insect. It is labelled "Pembrokeshire, Capt. Blomer" (J. C. D.), and at the side, "Haverfordwest." The capture of this specimen is recorded by J. C. Dale in "Loudon's Magazine of Natural History," vol. III, p. 332 (1830) as follows: "I beg to announce (should not Captain Blomer have previously given you the particulars) for the first time the capture of *Vanessa huntara* in Britain, by Captain Blomer, at Withybush, near Haverfordwest, South Wales (about ten miles from a seaport) in July or August, 1828; which was, till very lately, considered by him as a small and odd variety of *V. cardui* (or Painted Lady Butterfly), and which he has very handsomely added to my cabinet. Dr. Turton describes it as a native of North America (alone, I believe), from which place it might have been imported, but that remains to be proved, as I never yet heard of the importation of a *Papilio* in this way. . . ."

Vanessa antiopa, L.—Nine examples; one "From Latham, who had several brought to him about 1793—taken nr. London" (J. C. D.), also labelled at side, "Camberwell." This and a second specimen apparently from the same source, but with no label, are in good condition, considering their age. Two, rather old and faded, but still fairly good, "Kirkman's sale, 1847" (C. W. D.), and two "from J. G. Ross coll., 1882" (C. W. D.). Two old and much-faded specimens, one labelled "Barnsley" (C. W. D.), the second bearing a small triangular label with "Coley, sen." on one side, and "known to Weston, Yorks" on the other. The best example was "Caught by A. C. Jarman Frith at Lichfield, Aug. 30, 94."

Vanessa io, L.—Two examples (labelled at side "*var. Belisarius*, Obth.) with the ocellus on the hind-wings represented only by a large pale brown blotch. One of these bears a label "From Mr. Young of Hull, Feby., 1837" (J. C. D.) and on the other side, in different handwriting, "Took this, 1836, at Cottingham." Two with the rich chocolate-red ground-colour replaced by a peculiar madder-purple tint with a shade of grey, otherwise nearly normal; one of these is labelled "Bought of Pratt, sen., Brighton, 1872" (J. C. D.). A large but much faded specimen "Enborne, 1808" (J. C. D.).

Vanessa urticæ, L.—Two very fine examples of the *var. ichnusoides*, De Selys; the first, which is unlabelled, is practically a black insect with a broad, somewhat triangular streak of orange-red occupying the centre of the fore-wings, and with only traces of the red band towards the inner margin of the hind-wings. The second, labelled "Mr. Ross, 1880, Cardiff" (C. W. D.), has all three costal black spots on

fore-wings fused into a long black blotch, and the black dorsal blotch much elongated towards the hind-margin, which is broadly dark, the submarginal blue spots being entirely absent; the hind-wings, except for a narrow pale hind-margin, are quite black. A very pale example, "Budleigh Salterton, May, 1863, E. R. Dale," and another, very old and in worn condition, with pale ochreous-brown ground-colour, "From Rev. H. Burney coll., 1893" (C. W. D.). One with the ground-colour pale madder-brown, the usual yellow costal spots of the same tint, "Newport, 1900."

Vanessa c-album, L.—A very fine variety, quite parallel with var. *ichnusoides* of *V. urticae*, having the two outer costal spots of fore-wing enlarged and confluent, the discal spots absent, and the hind-wings much suffused with black. This appears to have been taken by the Rev. F. O. Morris in 1810 at Retford, Notts. A ♀ is as pale above and beneath as the S. European *V. egea*, Cr. One specimen is labelled "Glanvilles Wootton, Oct., 1816," and another, a ♀, "I of W., 1860."

Vanessa polychloros, L.—One ♀, much suffused and irrorated with brownish, giving the insect a rather dull appearance, and with the usual black spots of the fore-wings replaced by dark brown. "From J. G. Ross coll." (C. W. D.).

Argynnis paphia, L.—Two ♂♂ from the New Forest, with pale blotches in the centre of all the wings; one ♂, rather crippled, much suffused with blackish towards the hind-margins. A very fine ♀ aberration, having the black markings (with the exception of the one nearest the base) in the cell, and the whole of the central spots of the fore-wings suffused into a large irregular black blotch. This butterfly, which is in wonderfully good preservation considering its age of over a century, bears two labels, "From Donovan's Colln., taken in 1804"; and "S. Stevens coll., 1900" (C. W. D.). An extraordinary aberration, recorded by the late Mr. J. Jenner Weir as having been taken in the New Forest by Charles Gulliver in 1880 (Entom., vol. xiii., p. 206). In this specimen both gynandromorphism and dimorphism are combined, the left side being quite normal ♂, the right side ♀, with both wings, especially the fore-wing, a little crippled and reduced in size. The ground-colour of the fore-wing is rather pale olive-brown (as in some of the lighter examples of *valezina*), with a bright fulvous dash along the costa for about one-third of its length from the base. The hind-wing is longitudinally divided through the cell and along the fourth nervure into two sharply defined areas, the costal area being of the bright fulvous colour of the ♂, the inner marginal area being of normal *valezina* colour. The under-side, though exhibiting the corresponding sexual differences as above, otherwise departs but little from the normal type. Labelled "From J. G. Ross collection" (C. W. D.).

Argynnis adippe, L.—Two examples of the var. *cleodoxa*, Ochs., one old, on very old pin, but in good condition, without label; the other, "e mus. Dr. Abbot" (J. C. D.), and labelled also "Bedford" at side. Dr. Abbot's insects were purchased by J. C. Dale in 1817 (cf. Loudon's Magazine of Natural History, vol. III, p. 333).

Argynnis aglaia, L.—One ♂ with the spots in cell enlarged, and the central area of fore-wings rather strongly suffused with black; labelled at side, "n. Bedford," and probably one of Dr. Abbot's specimens. A curious small, suffused-

looking ♂, in rather poor condition, "*Arg. charlotta*, var. Blackpool, Aug., 1843, J. G. E." It is not, however, of that distinct variety, of which there are two specimens in the collection, a fine ♂ under-side, "Mus. Dr. Abbot" (J. C. D.), and at side, "Bedford," and another not so well marked, "Peterborough." Perhaps the most singular variety in the entire collection, indeed, of any butterfly that I have ever seen, is a ♀ of full size and well-developed, but with the body much bloated, and presenting generally a diseased appearance. On the upper-side the whole of the black markings and suffusion are replaced by a very peculiar tint, difficult to describe exactly, but perhaps best expressed by the term, "pale leaden-fuscous"; the fulvous ground-colour being slightly paler than in the ordinary form, and the distribution of the two colours is normal. On the under-side, the fore-wings are nearly as above, and the hind-wings are pale uniform leaden-brown, with no trace whatever of green; the usual silver spots being present and normal, but rather dull. There is not a trace of black pigment in any part of the insect, which is in good condition, but a little damaged at the anal angle of both hind-wings. It is labelled "Dover, Leplaistrier" (J. C. D.), and is thus referred to by the Rev. W. T. Bree in Loudon's Mag. Nat. History, vol. V (1832), p. 334, footnote ‡:—"A singular variety (of *A. aglaia*), pale buff-coloured, and with the black spots and markings very faint. It was taken, as I am informed, in a remarkably wet season. The specimen reminds me almost of some plant which, having grown in the dark, has in consequence produced its flowers nearly colourless."

Argynnis lathonia, L.—A series of 14 specimens; a ♀, "Mus. Dr. Abbot, White Wood, Gamlingay, Camb., June, 1803, Dr. Abbot" (J. C. D.), is fairly good; a rather poor specimen, "Halvergate, Norf., A. H. Haworth G. S.," is dated at side, "1818," and two good under-sides, "Birch Wood, B. Standish," bear the same date. A ♀ is "From Mr. Curtis," and two very good under-sides "Dover, Leplaistrier"; a better ♂, "Gray, Junior, Dover, 1880; others are "Dover, 1826," "Kirkman's sale, 1847," and "From J. G. Ross" (C. W. D.).

Argynnis euphrosyne, L.—A varied series, among them an old specimen with the basal black spots enlarged and confluent, and the marginal silver spots on the hind-wings beneath absent, "n. Bedford," probably one of Dr. Abbot's specimens. One with hind-wings and apex of fore-wings deeply suffused with olive-brown, "G. King, July 20/59." Two exceedingly fine dark varieties, "Taken near Colchester." The first is almost entirely dark rich brown on both sides, the black spots scarcely visible except on the hind-wings, in which each spot of the sub-marginal row stands in a dark fulvous ring. The silver spots on the under-side are normal, and stand out very brilliantly against the dark ground-colour. The second is even more singular, being above somewhat similar to the preceding, but more suffused with fulvous; on the under-side, the black basal spots on the right fore-wing are much enlarged and confluent. The basal half of the hind-wings is pale yellow, the marginal half red-brown; there is a large silvery longitudinal costal dash, and the central and marginal silvery spots are much enlarged, and the latter elongated towards the base of the wings.

Argynnis dia, L.—One under-side (apparently ♂) in fairly good order, but slightly worn; it is set low down on a rather old English pin. The label on one side is "Kirkman's sale, 1847," and on the other side is a note in C. W. Dale's handwriting, nearly illegible, but the name "Weaver" can be traced; a label at the side, "Warwickshire." This is probably one of the specimens reputed to have been taken by Richard Weaver at Sutton Park, near Birmingham, about 1830, which were recorded and figured by the Rev. W. T. Bree in "London's Mag. Nat. Hist.," vol. V, pp. 750-1 (1832). J. C. Dale also records Weaver's captures of *A. dia* in "The Naturalist," vol. I, p. 145 (Groombridge, 1838), and gives on Plate IV a fairly good coloured figure of the under-side.

Argynnis selene, L.—A fine variety, in which the usual fulvous tint on both sides is entirely replaced by clear ochreous-white or bone-colour. "From J. G. Ross, 1879." (C. W. D.).

Melitæa athalia, Bork.—A very varied series, including the beautiful example of the var. *pyronia*, Hüb. (*eos*, Haw.), which is figured on Plate IV, fig. 1, 2, of Stephens's "Illustrations." It is still in excellent preservation, and is labelled "*Eos*, Mr. Howard," and in C. W. Dale's hand-writing "Taken in 1802, Haworth Coll., Stevens Coll.," and at side "1803, Surrey." Another closely similar specimen (under-side) is rather more sharply marked above, and paler on the under-surface, "S. Stevens Coll. 1900" (C. W. D.), and at side "*Eos*, Haw. var." Other examples from the collection of the late Mr. S. Stevens have the hind-wings greatly darkened, and one has a broad central dark band on fore-wings; and an extremely fine variety, from the same source, is almost uniformly dark brown above, the submarginal row of fulvous spots, and a few faint indications of the basal spots of fore-wing, alone remaining. A large pale example is labelled "*Dictynna*, Haw.," and another curious-looking light form (very old) is labelled "From T. Cooke, Feb. or Mar., 1861" (J. C. D.), and at side "*tessellata*, Pet., var.," it agrees with the insect thus named, figured in Ill. Haust., plate V, fig. 1, 2.

Melitæa cinxia, L.—Another good and variable series; a large specimen with very pale ground-colour labelled "Folkestone" at side.

Melitæa artemis, Fab.—The series of this species includes examples from Glanvilles Wootton, Malvern, Penarth, Carlisle, Rannoch, Piteaple, Aberdeen, Westmeath, Galway, &c.; there are four specimens of the var. *præclara*, and seven of the var. *hibernica*, Birchall. A nice variety with the base of hind-wings broadly black is labelled "G. King, July 20.59" (J. C. D.). The two finest varieties are described by Mr. J. C. Dale, with good woodcut figures of the upper and under-sides, in London's Mag. Nat. Hist., vol. vi, p. 378 (1833). The first (fig. 47a, 48a), a ♀, has the hind-wing black, with a large fulvous blotch at the base, and the submarginal black spots in fulvous rings, the under-side being much suffused with dusky; it is labelled "Enborne, Berks., June 15th, 1813, Mr. St. Maur?." The second (fig. 47b, 48b), also ♀, is suffused all over with dark brown, the submarginal band of the hind-wings only being clear; it is labelled at side "South Wales; var. *signifera*," and is stated by Mr. J. C. Dale (*l. c.*) to have been taken by Captain Blomer at Haverfordwest.

Thecla betulæ, L.—A good series from Essex, Glanvilles Wootton, &c. *T. pruni*, L. Sixteen fine examples from Monk's Wood. *T. w-album*, Hubn. One with the W mark at anal angle of hind-wings obliterated. *T. quercus*, L. Two examples with the ocellus at anal angle of hind-wings without central black dot.

Thecla rubi, L.—A ♀ in very fine condition, curiously bleached, the hind-margins of all the wings quite pale brown.

Chrysophanus chryseis, F.—Three examples of this reputed British species, one ♂ labelled "Woodside, Epping, from Stephens, fr. Dr. Leach" (J. C. D.).

Chrysophanus virgaureæ, L.—Represented by eight examples, mostly in only fair condition. A rather worn ♀, on an old-fashioned English pin which has been cut off below the insect, is labelled "E. L. Capel-Cure on Cromer, Aug. 26, 1878, see Entom., v. XIII, 45" (C. W. D.). Five ♂ specimens are labelled—"Mus. Blom." (J. C. D.); "From Stephens" (J. C. D.); "Huntingdonshire, from Dr. Leach," at side "Yaxley"; "Griesbach Collection" (C. W. D.); "Haworth Sale 1824" (C. W. D.), the two latter being under-sides. Two ♀'s also bear the same label as the last mentioned, one having a label "Isle of Ely" at the side.

Chrysophanus hippothoë, L.—Four examples; one ♂ in very bad order, and one ♀, rather better, are labelled "from Latham" (J. C. D.). A ♂ has a large triangular label with "*Hippothoë*" on one side, and on the other "Mus. Haworth, Faversham, Kent" (C. W. D.), and a ♂ under-side, "Haworth's Sale, 1824" (C. W. D.).

Chrysophanus dispar, Haw.—The Dalean Collection contains one of the finest series extant of this now extinct British butterfly, numbering 26 specimens, 11 of which are ♂ and 15 ♀, one of the former and two of the latter sex being set to show the under-side. They are for the most part in excellent order, though a few antennæ are broken. Unfortunately very few bear any data; a ♀ is labelled "Whittlesea Mere, July, 1819," another (under-side) "Whittlesea Mere, July 8, 1833," and a third "Bred on June 23, 1841" (C. W. D.). Variation in size is very considerable; the smallest ♂ (measured as set, with the wings only slightly sloping) expands only 31 mm., and another is only a little larger, while the finest ♂ is 52 mm. in expanse. The smallest ♀ is 35 mm., and the largest 52 mm. across the wings. Two ♀'s are much suffused with copper-red on the basal area of the hind-wings, and another is much irrorated with black scales, and has the black spots very large. The gem of the whole collection is an almost entirely black ♀, the central area of the fore-wings, to the end of the cell, suffused with copper-red, on which the two basal black spots show up distinctly; the transverse submarginal band of black spots being just visible, but almost lost in the black suffusion. The hind-wings and under-side of this magnificent aberration are nearly normal. It is labelled "From Simmonds" (J. C. D.).

Chrysophanus phlæas, L.—A large and very varied series, including a very fine example of the silvery ab. *schmidtii*, Gerh., "From W. & D., 1899" (C. W. D.); a ♂ from Glanvilles Wootton has the right fore-wing, and a worn ♀ the left fore-wing, of the "*schmidtii*" colour. A very fine variety with the usual black spots very faint, and the disc of fore-wings, and submarginal band of hind-wings, a peculiar pale buff colour with only a slight coppery tint. A fine ♀ has the ground

dull copper, whitish towards the anal angle of fore-wings, and another of the same sex is light dull brown with hardly any metallic tinge, but the black spots large and clear. Two specimens have the submarginal copper band of hind-wings reduced to one or two elongate dashes, and a curious-looking ♂ lacks the submarginal black spots on fore-wings. Several approach the dark ab. *cleus*, F., and one is a very well marked example of that form.

Polyommatus alsus, L.—One or two from Dover, almost immaculate beneath.

Lycæna bœtica, L.—Two examples; a ♂ in fair condition, but badly set, "From J. G. Ross, 1882, who had it from boy who took it in Devonshire" (C. W. D.), "Dartmouth" at side. Another ♂, under-side, in fair condition, on a large common pin, "Elton, Trin. Coll., Camb.;" "Andover" at side.

Polyommatus acis, W. V.—A very fine series of 19 specimens, including several from Glanvilles Wootton. One ♂ "From J. G. Ross, 1878" (C. W. D.), is labelled at side "Cardiff." A fine ♂ has the ocelli on under-side very conspicuous, enlarged and somewhat elongated, and in another ♂ they are almost absent.

Polyommatus arion, L.—Fifteen specimens, chiefly from Barnwell Wold and Langport, Somerset. Two have the black spots on upper-side nearly obsolete, and in another way they are much enlarged and elongated.

"*Polyommatus alcon*, Steph., var."—Under this name is a specimen set to show the under-side, very old, but quite good, except that the abdomen is missing. On a triangular label is "*Alcon*, Hub., 263, W. J.," and at side "n. Bedford." The reference in C. W. Dale's "Register" is "var. *alcon*, Steph., from Mr. Haworth, H. Jones, Cliefden, Bucks." Whatever the origin of the specimen, it is almost certainly not a variety of *arion*, but agrees in every particular with specimens of *Lycæna alcon*, F., in the Oxford Museum and in my own collection. Cf. Stephens, Ill. Haust. I, p. 68.

Lycæna argiades, Pall.—A pair in good order; the ♂ has a circular ticket, "Dr. Marsh, 1874, Whatley"; the ♀, "Whatley, Somerset," at side. These would appear to be the specimens recorded by the Rev. J. Seymour St. John, in "Entomologist," vol. xviii, p. 292 (1885).

Polyommatus dorylas, Hübn.—One ♂, set to show the under-side, in fine condition, on a modern English pin leaning very much forward as is the practice with many English Lepidopterists. The label is very illegible, but appears to read "Burney's Sale, 1893, from Cooke, Zoologist, 8402" (C. W. D.). At p. 8402 of the "Zoologist" is a note from Henry Doubleday, dated January 12th, 1863, as follows:—"Mr. Cooke, of Oxford Street, recently detected two specimens of this species among a number of *Adonis* taken in England which he had purchased. One of these I have seen and it is certainly *L. dorylas*, and now that attention has been called to it, the insect will probably be met with in the coming summer." Mr. Dale's specimen is in all respects identical with *Lycæna hylas*, Esp. (= *dorylas*, Hübn.), of which species a specimen, "caught at Dover on 7th September, 1902," was exhibited by Mr. Sloper at the meeting of the Entomological Society of London on October 15th of the same year (Proc. Ent. Soc., 1902, p. xxxii). The butterfly, long ago well figured by Lewin ("The Insects of Great Britain . . .," tab. 37, fig. 5, 6; 4to; 1795), and noted by him as taken on a chalk hill at Dart-

ford, Kent, is in my opinion certainly *L. hylas*, and not, as it has sometimes been considered, an aberration of *L. bellargus* (cf. also H. Doubleday, Zoologist, p. 8467). It is just possible that, as in the case of *Lampides bœtica*, stray examples of *L. hylas* sometimes find their way to this country.

Polyommatus corydon, L.—The exceedingly fine series of 88 specimens of this species includes 2 ♂ of a light leaden-grey tint above, with hardly a trace of blue; one ♂ with entirely light hind-margins (var. *fowleri*, South, Entom., xxxiii, p. 104, plate III, fig. 4, 5), and another of the same sex, suffused above with black almost to the end of the cell. Two fine specimens of the ♀ ab. *syngrapha*, Bdv., one "from Meek, 1887" (C. W. D.), and the other "Newmarket." Several streaked under-sides of both sexes, and others with the ocelli on hind-wings more or less obsolete; but the finest is a ♀, normal above, but beneath of a pale and very peculiar clear greenish-white tint, slightly rayed along the nervures of the hind-wing with brown. All the usual ocelli are absent, except the discoidal lunule and the submarginal row of the fore-wings, and two costal spots near base of hind-wings; the marginal orange lunules are well marked on the hind-wings, are well marked and surmounted by faint black crescents, and the hind-margins of all the wings are brown, regularly interrupted by white spots between the nervures. This magnificent aberration is labelled "From J. G. Ross, 1880" (C. W. D.).

Polyommatus adonis, F.—Several examples with the ocelli of hind-wings beneath, except the discoidal lunule, obsolete or nearly so; and seven more or less blue ♀'s labelled at side "*ceronus*, Esp.," one very striking, but somewhat crippled.

Polyommatus icarus, Rott.—This species is represented by no fewer than 107 specimens from numerous localities, those from Sligo, Orkney, and Armagh being very fine and brilliant. Of aberrations, the most striking is a ♀, quite ordinary on the upper-side, but beneath modified much in the same manner as the remarkable *P. corydon* above described; the ground colour being clear whitish slightly rayed with brown on the hind-wings, the discoidal lunules of the fore-wings, and the submarginal series of orange spots with their surmounting black lunules very clearly and distinctly marked, but otherwise almost immaculate. This fine form was taken by J. C. Dale in Dorsetshire, on August 5th, 1826, and is labelled at side "Aug., 1826, Buckland." Another ♀, in which the outer row of ocelli on the fore-wings is elongated into strong black streaks, is labelled "Harwood, Colchester, 1899" (C. W. D.). There is a fine ♂ of a beautiful pale lavender-purple tint above, labelled "G. King, 1859" (J. C. D.), and at side "*Labienus*, Jermyn"; and a very handsome ♀, "Glanvilles Wootton, June, 1888" (C. W. D.), is very dark above, the outer third of the hind-wings light lavender-blue with submarginal black spots, the apex of the fore-wings also broadly blue.

Polyommatus astrarche, Bergstr.—Two of var. *alloüs*, Hübn. (one from Castle Eden Dene), quite immaculate above; a ♀ from Langport, Somerset, with clear white black-centred spot in cell above, "taken by Edward Paul, Esq.," is recorded by J. C. Dale in the "Naturalist," vol. i, p. 16. There are 21 examples of the var. *salmacis*, Steph., and 23 of var. *artaxerxes*, Fab.

Polyommatus egon, Bork.—A very fine gynandromorphous example, the right side being ♂ and the left side ♀, the sexual differences being equally well marked on the under-side, is "From J. G. Ross Coll." (C. W. D.). Two specimens are

labelled "Dover," one a curious small pale lavender-blue ♂, the other, of the same sex, very pale beneath with all the markings obsolescent. Another old ♂, probably from Haworth's Collection, taken near Holt, Norfolk, and labelled "*maritimus*" at side, is very dark beneath, with the ocelli of the fore-wings much elongated.

Nemeobius lucina, L.—The series includes several examples from Glanvilles Wootton.

Syrichthus alveolus, Hübn.—There are no fewer than fifteen examples of the ab. *taras*, Meig. (also labelled "*Lavatera*, Haw., var."), some of which are exceedingly fine. Three are labelled respectively "Meek, Standish Cabinet, 1830"; "Bedell Cabinet (J. C. D.)," and "Elton, Trin. Coll., Cam., 1894." A very dark example, with the white spots much reduced, "var. from J. G. Ross" (C. W. D.).

Steropes paniscus, Fab.—A good series from Monk's Wood, Hunts., and "Castor Hanglands, near Peterborough."

Pamphila comma, L.—One very light-coloured ♂, not labelled.

Pamphila linea, Fab.—A fine ♂ aberration, in which the fulvous ground-colour is entirely replaced by whitish-ochreous or bone-colour. "J. Williamson, Folkestone."

Pamphila lineola, O.—A fine series from Leigh, Essex.

Pamphila actæon, Rott.—This butterfly, discovered as a British species by J. C. Dale at Durdle Door, Dorsetshire, on August 15th, 1832 (C. W. Dale, "History of Our British Butterflies," p. 219), is represented by a good series from Swanage, Lulworth, and the "Burning Cliff," Dorsetshire.

"Aorangi," Lonsdale Road,
Summertown, Oxford:

April 9th, 1907.

(To be continued).

SOME NOTES ON THE *LEPIDOPTERA*
OF THE "DALE COLLECTION" OF BRITISH INSECTS, NOW IN THE
OXFORD UNIVERSITY MUSEUM.

BY JAMES J. WALKER, M.A., B.N., F.L.S.

(Continued from page 134).

II.—HETEROCERA.

The British moths in the Dale collections are contained in five cabinets and part of a sixth, and occupy 120 full-sized drawers. Almost every species on our list is more or less fully represented, in most instances by extensive series, and as in the case of the *Rhopalocera* already dealt with in the preceding pages of this volume, the number of fine and remarkable aberrations, and of specimens of historical interest, is very large. The rare Sphingines in particular are exceptionally well represented, and among these are what are without doubt the first authentically recorded British examples of *Charocampa nerii* and *C. celerio*.

SPHINGINA.

Zyguena exulans, Hoch.—A fine series from Braemar. *Z. meliloti*, Esp.—Also well represented, and including a fine confluent form.

Z. lonicerae, Esp.—One example of the var. *eboraci*, Prest, from Castle Eden; three fine varieties with the crimson spots on fore-wings confluent into a large blotch, one of them labelled "Warwick, from H. D., /58" (J. C. D.).

Z. trifolii, Esp.—One fine yellow aberration (labelled *lutescens*, Tutt), "Mr. Christy, Emsworth, Hants, 1895" (C. W. D.); several very fine examples with confluent spots, and one, labelled at side "*orobi*, Hubn.," with the central crimson spots of fore-wings much reduced in size, "W. Head, Scarborough, 1906" (C. W. D.).

Z. filipendulæ, L.—Of this abundant species there is a large and varied series including two fine yellow forms (*cerinus*, Robson) from "Winchester, C. Goddard, 1875"; two fine confluent aberrations with the basal and central crimson spots fused into a large blotch, the finest from "W. Head, Scarborough, 1904" (C. W. D.); and another with the same data, in which the crimson colour is replaced by pale orange-red. A magnificent melanic form (var. *chrysanthemi*, Esp.), obtained by C. W. Dale at the sale of Dr. Mason's collection in 1905, and bearing a type-written label "BEWDLEY, T. NOWERS" (*recte* "Nowers"). In this beautiful aberration the whole of the usual crimson colour is replaced by very dark madder-brown, the spots distinctly visible on the lustrous blackish-green ground colour of the fore-wings. An even more remarkable aberration is of full size and well developed, but the whole of the dark-green scales of the fore-wings are absent, these wings being transparent horn-colour with narrow blackish costal margin; the usual dark border of hind-wings, and all the fringes are pale grey; all the crimson markings, and the body, being normal, and the under-side being modified nearly as above. This specimen was taken by Dr. R. C. R. Jordan, and is labelled "Cliffs, Teignmo., June 12/44," presumably in his handwriting.

Smerinthus ocellatus, L.—The series includes an example of the hybrid between this species and *S. populi* (labelled var. *hybridus*, Westw.). The characters of this insect are decidedly ♂, and in general appearance it much more closely approximates to *ocellatus* than to *populi*. It was obtained by J. C. Dale from Mr. H. House, of Bristol, in 1840. (Cf. Trans. Ent. Soc., vol. III, pp. 193–202 (1842).

S. populi, L.—A curious small ♂, almost unicolorous pale brown, the usual red blotch on hind-wings absent. "From B. Standish, Walworth, Kent" (C. W. D.).

S. tiliæ, L.—A varied series, including several specimens with the central band on fore-wings reduced, in one ♀ hardly traceable, the insect being of a nearly unicolorous pale red-brown tint; "Meek, 1880" (C. W. D.). Another rather striking ♀ specimen is nearly uniform light olive-brown, with the central band well marked, and of a full orange-brown colour; labelled at side "Doncaster."

Acherontia atropos, L., and *Sphinx convolvuli*, L.—Full series of both species, but none of special interest, historical or otherwise.

Sphinx pinastri, L.—Eight examples; a ♂ in very fair condition, "From Dr. Leach, F.R.S., taken near Edinburgh" (J. C. D.), and at side, "Rivelston Wood, near Edinburgh, Mr. Wilson, 1818." (Cf. Stephens, Ill., Haust. I, p. 122.) Two ♀'s, both worn, "Bought at Stevens's, 1893, Rev. H. Burney's collection" (C. W. D.); another ♀, in fair condition but badly set, "Honble. Miss Lushington, Surrey" (C. W. D.), and a better specimen of the same sex, "Aldeburgh, 1884, 24 March (?) " (C. W. D.); while a ♂ in excellent condition is labelled "Aldeburgh, Suffolk (illegible) from Mr. Ross' coll., 1888" (C. W. D.).

Deilephila euphorbiæ, L.—Also represented by eight examples, six of which are from the old locality of Branton Burrows, North Devon. These include a ♂, "Devon, Barnple., Mr. Raddon" (J. C. D.); another ♂, very strongly tinged with rose-colour, "Bred by Raddon, Branton Burrows, F. Standish bt." (C. W. D.); two ♂, "Bred by the late Mr. Raddon. The larvæ taken on the sandhills at Branton near Barnstaple"; a ♂, "Rev. Windsor Hambrough collection. Given to him by Mr. A. R. Raddon the son"; and another ♂, in rather poor order and apparently worn from flying, "Barnstable, Mr. Raddon," and at side, "1815." Of more recent specimens, a very good ♀ is labelled "Taken in the Isle of Man, sitting on dead sea weed, July 15th, 1868, by Chas. S. Dewhurst"; and another ♀, from the collection of the Rev. J. Seymour St. John, bears a printed label evidently cut out of a sale catalogue, "*D. euphorbiæ* bred from larvæ taken at New Quay in 1889, with cocoon and pupa case (Ent. vols. xxiii, 18, 319, and xxvi, 314)."

D. galii, W. V.—Nine specimens; two rather small ♂ from "J. G. Ross' coll., 1888" (C. W. D.); a fine large example of the same sex, "From Rev. H. Burney's collection, 1893" (C. W. D.), "Birkenhead" at side. A ♀ with printed label, "bred by Mr. Leather, Liskeard," and another, "Birkenhead, J. T. Carrington, 1873" (C. W. D.). Two ♀'s, "Mus. Spry," "Middlesex" at side, and "Dr. Knaggs's coll., bred by Syme." A finely coloured ♀, "bought of Mr. Reade, Doncaster, 1837" (J. C. D.), and a very large but worn example of this sex, expanding as set 3 inches 3 lines (= 82 mm.), "Deal from J. G. Ross' coll., 1888" (C. W. D.).

D. lineata, Fab. (*livornica*, Esp.).—Eight examples; a ♀ labelled "Mus. Dr. Abbot" is in very good condition considering its great age. (Cf. Stephens, Ill.,

Haust. I, p. 127.) Two rather worn examples, both ♀, "From collection of Mr. Edmonds of Worcester" (C. W. D.). A very good ♂, on a large ordinary pin, "From J. B. Hodgkinson, Deer, 1869. Taken at Workington by B. Martin"; another ♂, somewhat worn, "Thornford, nr. Sherborne, Mar. 28, 1862." A very good ♀, "Taken in Devonshire at Plympton. Capture recorded in Science Gossip for 1869." Respecting this specimen the captor, Mr. F. A. Ramsey, writes (Science Gossip, March, 1868, p. 65): "Suspecting one of my two specimens (taken last season) to be a female, I kept it alive some time; it laid a small number of eggs, and died. I think about thirteen of the eggs hatched; I placed them on a growing vine in an airy box; some of them grew to about $1\frac{1}{4}$ inch in length, but all ultimately died." Two other ♀'s in good order, one Feby. 2nd, 1861, near Torquay, Geo. King, in Intell., p. 155" (Ent. Weekly Intelligencer, vol. IX), and one, very fine, "Taken by E. R. Dale, Gl. Wootton, Dorset, Aug. 22, 1870."

Chærocampa nerii, L.—The collection contains five examples of this rare visitor to our islands. Of these, the most interesting is a ♂, a little faded in colour, but otherwise in good condition with the exception of a small piece out of the apex of each fore-wing, and the top of the head rubbed bare. It is labelled "Taken at Dover by Mr. Leplastrier" (C. W. D.), with a printed label at side, "Dover, Mr. Le Plaistrier, Sept., 1828." The latter date is almost certainly erroneous as regards the year, as the first record of the capture of the imago of *C. nerii* in our islands appears in the "Entomological Magazine" for 1833 (vol. I, p. 525) as follows:—"Discovery of *Sphinx Nerii* in England. Sir,—Another addition has been made to our visiting *Sphingidæ* by the capture of the splendid *Deilephila* (may I call it?) *Nerii* at Dover about ten days since. From the state of the specimen, which I have this day examined, it must have been very recently disclosed, the tips of its wings and the top of its head alone being slightly injured by its captor, a lady residing in the above town. * * * J. F. Stephens, Sept. 16th, 1833." The specimen now under consideration is slightly damaged in precisely the same manner as above described. It seems also reasonable to suppose that it was from this example that the beautiful figure in Curtis' "British Entomology," plate 626, was drawn. Curtis (*l. c.* fol. 626, p. 1) at the time this plate was published (January, 1837) apparently knew of only two British-taken *C. nerii*, one of which was in the cabinet of his fellow-worker, J. C. Dale, and was presumably lent to him for the purpose of being figured. This figure, although more fully and richly coloured than the moth is now after the lapse of nearly three-quarters of a century, agrees with it in a remarkable and convincing manner in all the minute details of the markings; and though Curtis states (*l. c.* fol. 626, p. 2), "The fine specimen of the moth, which is a female, Mr. Leplastrier informed me was taken by a poor man the latter end of September, 1834, near the pier at Dover, and was brought to him alive," the antennæ in the figure, which are very faithfully represented, are obviously those of a ♂. It therefore appears to me that these two somewhat discrepant records refer to the capture at Dover of a single specimen of *C. nerii* which came into the hands of the well-known collector Mr. Leplastrier, and from him passed to J. C. Dale; and that this, the first example of this beautiful moth known to have been taken in Britain, has thus been handed down to our time.

The other four specimens of *C. nerii* in the collection are labelled as follows:—

One ♂, old but perfect, "Honble. Miss Lushington, Sussex" (C. W. D.); a ♂, in very good order, has two labels in C. W. Dale's handwriting, "Taken at Eastbourne by a small boy from Bayswater, about 9.30 in the evening circling round a very brilliant light. From the Bayswater Chronicle of Sept. 27th, 1884," and "R. Alfred, Eastbourne, Sept. 24th, 1884, Cat. n. 17—333." One ♀, very richly coloured, but slightly rubbed on the thorax and with one antenna missing, the body being not very neatly stuffed with cotton-wool, "From the colleen. of late Dr. Hunter, died 1892," at side "Hartlepool"; and a very fine ♀ on a modern black pin, "*Chærocampa nerii*, captured at Poplar, 20th Sept., 1888."

C. celerio, L.—Seven examples; of these a ♂, in surprisingly good condition, considering its evident age, is without doubt the first recorded British specimen. Its label, in the same style and handwriting as those on many other insects originally in A. H. Haworth's collection, and presumably written by him, is "Celerio, Bunhill Fields, Fcn." Stephens (Ill., Haust. I, p. 128) says, "The first recorded specimen of the perfect insect was taken flying in Bunhill-fields burying-ground so long ago as July, 1779; and the specimen now exists in a high state of preservation in Mr. Haworth's cabinet, having been purchased by him at the dispersion of that of Mr. Francillon." A rather worn ♂, "Taken at St. Leonard's, Sussex, 1866," and another ♂, slightly rubbed, "Taken by a woman at Glanvilles Wootton on Sept. 12th, 1885" (C. W. D.). A very old specimen of the same sex is labelled "*Celerio*, Brighton, J. G. Children, Esq." A ♀ in capital order, "Taken by a boy at Teignmouth, 1880, had from Mrs. Vernon Wollaston" (C. W. D.), and another ♀, not so good, "Taken by P. C. Lloyd at Bognor, Sussex, August, 1885."

C. elpenor, L.—A curious ♂, in which the usual rose-colour is entirely replaced by olive-brown, "Gl. Wootton, C. W. Dale, bred 1871" (C. W. D.).

Sesia asiliformis, W. V.—Seven examples; one ♂, "Ashford, Kent, from Dr. Harper's coll. Briggs coll., 1891" (C. W. D.); one ♀, "Epping Forest, Mus. M. & M., 1840"; one ♀, "Hanson's Sale at Puttick, &c., 22 Novr., 1889," and another of the same sex, much damaged by verdigris, "From J. F. Stephens" (C. W. D.), and at side, "Colney Hatch, Middlesex."

S. chrysidiformis, Esp., and *S. muscæformis*, View.—Good series of both species, from Folkestone and Cornwall respectively.

S. allantiformis, Newm.—Of this "Clearwing," until very lately so rare in our collections, there are seven specimens. A ♂ in good order, "Greenhithe, Kent, Meek, 1878, for £4 10s., taken by James Briant" (C. W. D.); a ♂, "Briggs coll., '96, from Standish cabinet" (C. W. D.). A very nice ♂, "Gl. Wootton, Aug. 23, 1902" (C. W. D.), recorded in Entom., vol. xxxv, p. 286; in which note Mr. C. W. Dale withdraws his record (Entom., vol. xxvii, p. 245) of *S. conopiformis* as a British species, this having been introduced on a ♀ specimen labelled "Brockenhurst, C. Gulliver, July 19, 1894." A very good ♀, "J. G. Ross coll., 1900"; another ♀, "Swanscombe, T. Sirey, 1877, Briggs sale, 1896, for £3" (C. W. D.), and a small example of the same sex, "N. F., Gulliver, 1902" (C. W. D.).

S. culiciformis, L.—Two orange-banded examples, labelled at side, "*v. Thynnaiformis*, Zell," one of them "From Davis, Dartford" (C. W. D.).

S. sphegiformis, Schiff.—A good series from Tilgate Forest.

S. scolæiformis, Hubn.—Four examples from Rannoch, and four from Llangollen; one of the latter labelled "N. Cooke, July 13, 1862."

(To be continued).

SOME NOTES ON THE LEPIDOPTERA OF THE "DALE COLLECTION"
OF BRITISH INSECTS, NOW IN THE OXFORD UNIVERSITY
MUSEUM.

BY JAMES J. WALKER, M.A., R.N., F.L.S.

(Continued from Vol. xliii, p 158)

Reprinted from "The Entomologist's Monthly Magazine," 2nd Series, Vol. xx.

BOMBYCINA.

Lithosia quadra, L.—One exceedingly dark ♂, with the central area of the fore-wings broadly deep smoky-grey. "From J. G. Ross coll. 1879" (C.W.D.)

Eulepia grammica, L.—Two ♂ and two ♀ specimens of this exceedingly rare (or doubtful) British species. A ♂ in fairly good order, on a very old-fashioned pin, is labelled "E. Donovan, Manachty, Anglesea, 1800" (C.W.D.). (Cf. Stephens, Ill. Haust. Vol. II, p. 92). Another ♂ also fairly good, but evidently repaired, "Capt. Russell, Wrexham, July 1859 (C.W.D.), and "Mercer's sale 1871 (C.W.D.). A very pale ♀ in tolerable condition, on an old bead-headed pin, "From Dr. Leach" (C.W.D.); and another very aged example of the same sex bears three labels; "Windsor" in much faded ink; "A. Mercer's sale 1871" (C.W.D.) and "from Dr. Leach" (C.W.D.).

Deiopeia pulchella, L.—A fine series of twelve examples, nearly all in good condition. A large ♂, "Hon. Miss Lushington, Sussex" (C.W.D.), another ♂, "From Mr. Ross, 1883" (C.W.D.), at side, "Littlehampton"; and a rather pale example of the same sex, "Saltern Cove, Paignton, Devon, J. A. Lilly, 1875," A ♀ "Hurne, Oct. 1818" (J.C.D.) is probably the specimen noted in Ill. Haust. Vol. II, p. 93, as "a fine ♀ in (the cabinet) of Mr. Dale found by him in a stubble field, near Christchurch, Hants, at the end of September, 1818." Three ♀'s labelled in identical handwriting "Bournemouth," and the second has in addition, "See Entomologist, Vol. 9, p. 259" (C.W.D.); the third is very brilliant in colour, but lacks the antennæ. Of four ♀ examples labelled at side "Brighton," one has the additional label, "Hon. Miss Lushington, Sussex" (C.W.D.), and the last, a very fine ♀ "Taken near Pelham, 1896."

Euthemonia russula, L.—One rather striking variety of the ♀, having the fore-wings pale orange in colour, much powdered with black scales, and the hind-wings almost entirely black.

Nemeophila plantaginis, L.—Specimens of the var. *hospita*, W.V., from "Yorkshire" and "Ambleside," a ♂ from the former locality having the central black markings of hind-wings almost obsolete. A much more striking aberration has the white markings greatly reduced, the hind-wings being entirely black except for a narrow transverse apical streak. This specimen has at the side a printed label "Matronalis." Two ♀'s "Mr. Head of Scarborough, 19.4" (C.W.D.), are very richly coloured, the usual orange tint of the hind-wings and body being replaced by deep crimson, with which the costa of fore-wings is also suffused.*

* This is the usual form of the female of var. *hospita*, only the male possesses the white ground colour.—G. T. P.

Callimorpha dominula, L.—A magnificent melanic aberration, in which the usual orange and cream-coloured spots of the fore-wings are slightly enlarged, and entirely replaced by an intense shade of the deepest madder-brown, showing up darker than the ground-colour, which is slightly more bluish in tone than usual. Hind-wings and body deep glossy black; under-side immaculate black, slightly glossed with green towards edges of wings. This specimen, which is a ♂, and is figured in the "Entomologist," Vol. VI, p. 321, bears two labels, "St. Margaret's Bay, Dover, bred 1872," and "S. Stevens sale, 1904" (C.W.D.).

C. hera, L.—A good series, including some fine examples of intermediates between the red and yellow forms of the species.

Chelonia caja, L.—A series of 50 specimens, containing several good aberrations, but none that are particularly striking. The best is a ♂, with the white markings of the fore-wings much reduced, and the hind-wings smoky-fuscous, clouded with dull yellow at the base, the black spots smudged and suffused and without any blue tint, "S. Stevens coll. 1900" (C.W.D.). A ♀ from "Wellman's coll., 1874" (C.W.D.), has the pale ground-colour of fore-wings much extended towards the hind-margins, and tinged with brownish, the basal and central brown markings suffused into a large blotch divided longitudinally by a pale streak, hind-wings light orange. Two with pale yellow hind-wings, and one with the spots on the hind-wings much enlarged.

Phragmatobia fuliginosa, L.—A remarkably pale ♂ "Scotld. from Weaver, 1845" (J.C.D.).

Arctia lubricipeda, L.—A fair series of the var. *radiata*, Haw., including some old specimens from "Saltfleet, Lines."; also a very old, badly pinned and set specimen of the var. *fasciata*, with two labels in Haworth's handwriting "817, 3 var," and "Hull, Mr. Young." A curious small ♂, with smoky-grey fringes to both wings "G. Woott." E. R. Dale (C.W.D.)

A. menthastri, L.—A very good ♂ specimen of var. *walkeri*, Curtis, on an old pin, with label "2 β"; another very old example much suffused with smoke-grey. Several examples (var. *ochracea*, White) having the ground-colour of fore-wings clear pale ochraceous-yellow, one labelled "Wellman coll., 1884" (C.W.D.), and "Aberdeen, Horne, /93." A very fine ♂ of the extreme Scotch form, with the fore-wings of quite a deep umber-brown, "Elgin, McTavish, 23 Jly/94," and another, somewhat less dark, "Forres."

A. urticae, Esp.—Two fine ♂ aberrations of an uniform smooth smoky-grey shade, on rather old gilt pins, labelled at side "Yorkshire."*

Spilosoma mendica, L.—Several specimens from Cork, of var. *rustica*, Haw., and a remarkable ♀ aberration, with quite immaculate wings except for a small dot at the lower end of the cell, but head, thorax, and abdomen entirely deep black.

Ocneria dispar, L.—A fine series of the "old fen form," one ♀ labelled "Whittlesea Mere, July 17th, 1824" (J.C.D.), measuring as set 2 inches, 10½ lines (= 72 mm.) One or two ♂'s are very dark and uniform in colour, and a large ♀ is almost immaculate. There are also two ♂'s with the fore-wings very pale, almost the colour of the ♀, but with broad dark hind-margins.

* There is no authentic record of the capture of *Arctia urticae* in Yorkshire.—G. T. P.

Liparis salicis, L.—An unusually large ♀, labelled “Christchurch” measures 2 inches $4\frac{1}{2}$ lines (= 59 mm.) in expanse.

L. monacha, L.—A fine ♂, suffused all over the wings with dark grey “New Forest, Salvage, 1899” (C.W.D.) and at side “*V. eremita*, Och.” A ♂ with the ground-colour much suffused with light brownish, and all the usual markings pale and indistinct. A fine asymmetrical ♂ aberration, with the central markings of fore-wings suffused into a broad bar, solid black on the left side, and marked on the right costa with white. “J. C. Dale, Blandford, Sept. 4th, 1838” (C.W.D.). A ♀, entirely black to beyond the middle of fore-wings, “New Forest from J. G. Ross, 1880” (C.W.D.) and two ♀’s with all the black markings reduced to slender lines.

Laelia cænosa, Hübn.—Fifteen examples in good condition; one very large ♂ expanding nearly 1 inch, 11 lines (47 mm.), is labelled “B. Standish, Whittlesea Mere, August, 1821” (J.C.D.); a fine ♀ bears a similar label, and the remainder are mostly from Wicken Fen.

Laria pudibunda, L.—Two ♀’s with the fore-wings uniform brownish-grey, and all the usual markings obsolete. “Scarboro’ 1903” (C.W.D.), and “from W. Head, Scarborough 1904” (C.W.D.).

Lasiocampa rubi, L.—A ♂ with the transverse lines widened, approximating, and in part coalescing, forming a rather broad pale band. “From Robson’s Coll., 1895” (C.W.D.).

L. trifolii, W. V.—Four examples of the pale form from Romney Marsh, labelled at side “*v. medicaginis*, Bork.” Of these one ♂ is “From Robson’s Coll., 1895” (C.W.D.), a ♀ “From J. Weir’s Coll. 1884” (C.W.D.), and another fine ♀ has a type-written label “Romney Marsh, Mitford, E. M. M., March, 1873.”

L. quercus, L.—A varied series, including a fine, but slightly worn, ♂, almost entirely deep chocolate colour, the central spot and sub-marginal band being indented in an olive-brown tint; “From Mr. Head, Scarborough, 1904” (C.W.D.).

Odonestis potatoria, L.—A ♂, labelled at side “Wicken Fen,” entirely of the normal colouring of the ♀. “From J. G. Ross, 1884” (C.W.D.).

Gastropacha ilicifolia, L.—A very fine series of fifteen examples (8 ♂, 7 ♀). Two ♂’s are labelled “Foxcroft” (C.W.D.), a ♂ “by Mr. Edwards,” and two ♂’s and two ♀’s “Standish” (C.W.D.). A ♂ and a ♀, “Cannock Chase, from R. Weaver 1856” (C.W.D.), a ♀ “Cannock Chase, Downing’s Sale 1894” (C.W.D.), and a ♀ “B. Standish, Downing’s Sale 1894” (C.W.D.).

Saturnia carpini, Bork.—An unusually dark ♀ with strong rosy suffusion over both wings, “Aberdeen, 1890.”

Endromis versicolor, L.—A ♀, “Old Standish, 1820” (J.C.D.), is labelled at side “Darenth Wood.” Another ♀, labelled “Standish, Rannoch, May 1857,” is the largest example of this species I have ever seen; it expands 3 inches, 6 lines (= 37.5 mm.).

Cerura vinula, L.—One ♂, apparently bred, in which the usual grey pencillings of the fore-wings have quite disappeared, leaving only the sub-basal transverse band; and a very fine ♀, with the fore-wings unusually dark grey, especially towards the inner margins; the hind-wings are smooth smoky-black with pure white fringes, and the dark markings on the abdomen are much enlarged. Both these aberrations are labelled “from Mr. Head, Scarburgh, 1904” (C.W.D.).

C. bicuspis, Bork.—Eleven examples, some of them much discoloured by age. Among the better specimens are one very fine ♂ “from Mr. Tester” (J.C.D.), another “from T. Wilkinson, 1860” (J.C.D.), and two “From Lovell Keays coll. 1900” (C.W.D.).

Stauropus fagi, L.—A good series, including a fine pair of the now well-known melanic form, “Marlow” at side; “from W. Harwood, 1877” (C.W.D.).

Notodonta tritophus, W. V.—Three examples of this great rarity; a ♂ in very fine condition is interesting as being in all probability the specimen on which the species was introduced as British by the late Mr. J. W. Douglas, and which afterwards passed into the possession of the late Dr. P. B. Mason; it is labelled “J.W.D.,” and “Bred from larva found in Essex. Douglas.” (Cf. Barrett, Lep. Brit. Islands, Vol. III, p. 117). A more recent, but not quite so good ♂ specimen, “Gravesend from Coll. Whitsmith” (C.W.D.), and a third, also a ♂, but somewhat damaged, “late Mr. Turner” (C.W.D.); “Rannoeh” at side.

Gluphisia crenata, Esp.—Represented by two examples, a ♂, apparently bred, with a printed label “Epping”; a ♀, apparently older than, and not in as good condition as the other, “From J. Jenner Weir’s collection, May 29th, 1894” (C.W.D.).

Microdonta bicolora, L.—A pair from “Killarney”; the ♂ has a MS. label “Bouchard,” the ♀ bears a printed label (apparently cut out of a sale catalogue) “Bouchard, Killarney, July, 1864.”

Clostera reclusa, W. V.—A striking aberration, of large size, the ground colour uniform dark chocolate-brown, without markings except the pale transverse lines, which are clear and well-marked. “From Mr. Ross.” (C.W.D.).

Macrogaster arundinis, H.—A good series, including some exceedingly large ♀ specimens from “Whittlesea Mere.”

Hepialus hectus, L.—A fine ♂ aberration, with the usual silvery markings occupying more than half the area of fore-wings. “Inverary” at side.

Drepana sicula, L.—Fifteen examples, all apparently bred; labelled “Leigh Wood, Bristol,” at side.

(To be continued).

Aorangi, Lonsdale Road,
Summertown, Oxford:
March, 1909.

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(Continued from p. 110).

Reprinted from "*The Entomologist's Monthly Magazine*," 2nd Series, Vol. xx.

GEOMETRINA.

Zonosoma orbicularia, Hübn.—A small ♀ example, in which the black dots forming the usual transverse lines are replaced by strong longitudinal black lines, giving the insect a curious radiated appearance. "Head, Scarboro" (C.W.D.).*

Pseudoterpna cytisaria, W. V.—A rather remarkable ♂ variety in which the usual green tint is replaced by clear darkish grey, the central band being well marked; it is on an old pin, but is fresh-looking and in excellent condition. A ♀, also in good order, is smooth dark smoke-grey on both surfaces.

* This would not be a Scarborough specimen, as the species is not known to occur in Yorkshire.—G. T. P.

Geometra papilionaria, L.—A large and fine ♀ specimen from Glanvilles Wootton, of an uniform clear rich creamy-ochreous colour above and below, slightly deeper in tint towards the costa and hind-margin of fore-wings, and the usual markings obsolete and scarcely traceable. This specimen, which is in bred condition, shows under a strong lens no trace whatever of discoloration, fading or chemical treatment, and would seem to be a natural aberration. Cf. Barrett, Lep. British Islands, Vol. vii, p. 282.

Rumia cratægata, L.—A large ♂, in which the sulphur-yellow ground-colour is entirely replaced by ochreous-white, the usual ferruginous marks on costa, &c., being normal. The specimen is an old one and is labelled "Capt. Blomer" (C.W.D.), and at side "Devon."

Venilia maculata, L.—A fine example of the var. *quadrimaculata*, Hatch, the usual markings being very faintly traceable, and the costal spots only a little darker than the ground-colour; "from Briggs sale 1896" (C.W.D.), and at side "Abbot's Wood."

Cleora glabraria, Hübn.—A ♂ and a ♀, both having the fore-wings curiously and irregularly blotched with blackish; both "from J. G. Ross" (C.W.D.).

C. viduaria, W. V.—Seventeen specimens of this now very rare species, mostly in very good order, several being on fairly modern gilt pins; one of these latter, a ♂, is labelled "H. Vaughan 23-4-90." A fine ♂, "J. C. Dale, June 2, 1823" (C.W.D.), another, "F. O. Standish coll., p. 1880"; a ♀ "Mr. Weaver (?), June, 1825" (C.W.D.), and a very fine example of this sex, on a rather modern pin "E. Janson, senr."

Boletobia fuliginaria, L.—Eleven examples, some of them very fine. Three ♂'s and one ♀ "Bermondsey, Wellman, 1884" (C.W.D.); a ♀ on a very old bead-headed pin, "Haworth coll." (C.W.D.); a ♀ "Taken at Lewisham, August, 1886, from Jenner Wein's collection"; and another of the same sex, "Taken by my gardener in a cellar at Lewisham among a lot of old wood and osiers, and seen by me when fresh killed. G.W.S."

Fidonia atomaria, L.—A varied series, including two very small ♀'s almost entirely black; these are labelled at side "Carbonaria, Haw. var." One of them, on a very old short bead-headed pin, bears Haworth's characteristic small square label of blue paper, and may possibly be his type-specimen of the variety. Cf. "Lepidoptera Britannica," p. 281.

Aplasta ononaria, Fuess.—One ♀ example, in very good order, but has evidently been repinned at some time or other. "Folkestone, 1867, Mr. C. Woods."

Lythria purpuraria, L.—Two examples, set low down on rather modern gilt pins, in good condition except that the antennæ are broken. The ♂ is labelled "Ross Coll." (C.W.D.), and the ♀ "from E. G. Meek, 1870, said to have been taken by Mr. Button at Gravesend" (C.W.D.).

Aspilates strigillaria, Hübn.—A fine ♂ aberration, almost uniform dark grey-brown all over, the markings all but obsolete; "Mr. Head b. Scarborough, 1904" (C.W.D.). A ♀ of the var. *inequaria*, Haw., is labelled "Winchester, 1841" (J.C.D.).

Sterrrha sacraria, L.—Thirteen examples; a ♂, much worn, "Holwell, E. R.

Dale, Aug. 31, 1867" (C.W.D.); another ♂, on a very old short common pin, "Bristol," and a third ♂, with very obsolete markings, "J. C. Dale, I. of Wight, Aug. 21, 1865" (C.W.D.), and at side "Freshwater." The remainder bear no data, but are mostly in good condition, and include several finely marked ♂'s and one ♀ strongly suffused with rose-pink.

Timandra amatoria, L.—A very fine ♂ aberration, of a smooth fuscous-brown colour all over, the markings slightly indicated in a darker shade, but the usual rosy tint entirely absent. "E. R. Dale, Bishop's Caundle, July, 1864" (C.W.D.).

Acidalia herbariata, F.—Three examples, labelled "London" at side; one in rather poor condition, "From Rev. H. Burney's coll." (C.W.D.). *A. circellata*, Guén.—Ten examples of this now very rare form from Chat Moss; four of them are labelled "Briggs coll., 1896" (C.W.D.). *A. strigaria*, Hubn.—Two examples with no further data than "Gravesend" at side. *A. perochraria*, Fisch.—Three specimens, one "Dr. Knaggs coll., see Ent. Ann., 1871"; the other two "C. Briggs coll., 1896" (C.W.D.).

Melanippe fluctuata, L.—Two fine examples of the var. *costovata*, Haw., and a very remarkable aberration, suffused all over with sepia-brown, the central band of a darker shade of the same colour, well marked, but very narrow and parallel-sided. This specimen, which lacks the head and is otherwise in rather poor condition, is labelled "June 21, 1818" (J.C.D.), and at side "Whittlesea."

M. montanata, W. V.—One ♂ specimen almost without markings except the discoidal spot and a faintly indicated narrow costal blotch, labelled "Newcastle"; another ♂ is deep fuscous-brown all over, the central band fairly well marked but not much darker than the ground-colour. Labelled "Cocks, Devon," at side.

Abraxas grossulariata, L.—A few fairly good pale and confluent aberrations, and two of the now well-known var. *varleyata*, Porritt, from "Briggs coll., 1896" (C.W.D.).

Melanthia ocellata, L.—A very remarkable aberration, all the wings being uniform fuscous or sepia-brown above and below, except that on the upper-side the discoidal spot and hinder edge of the central band of fore-wings are faintly indicated in a darker shade of the same colour. This specimen, which is much damaged on the left side, bears a partly printed label with figures added in MS., "Jul. 8, 1825" (J.C.D.); also a rather more illegible label than usual in which a reference to "Apr/90" can alone be made out (C.W.D.), and "Dunkeld" at side.

Ypsipetes elutata, M. V.—A very small ♀, entirely of a smooth, pale, ochreous-olive tint, the transverse markings and apical streak indicated only by faint dark dots on the costa; another ♀ is slightly paler and greyer in ground-colour, the usual markings indicated in light ochreous-brown. Both labelled "Scarboro, 1895" (C.W.D.).

Cidaria reticulata, W. V.—A fine series of 14 specimens, apparently bred; two of these, one being a large and unusually dark ♀, "Downing's Sale, 1894" (C.W.D.), and two others "from Hodgkinson" (C.W.D.).

Phibalapteryx polygrammata, W. V.—A fine series of 23 examples of this practically extinct British species, the majority being labelled "Briggs coll." (C.W.D.),

"Downing's Sale" (C.W.D.), and "Brown of Cambridge" (C.W.D.). "Burwell Fen" at side.

Eupithecia innotata, Hübn.—Four specimens, one labelled "Cocks" (J.C.D.). "Norfolk" at side.

Eubolia mæniaria, W. V.—Two examples, ♂ and ♀, of this rare British moth, both in good order, on old bead-headed pins, but unfortunately without data except a label on the ♀ "*mæniaria*, F.," and "Yorkshire" at side.

NOCTUINA.

Bryophila algæ, Hübn.—Two examples; a light-coloured ♂ on a gilt pin labelled "from Meek, 1878" (C.W.D.), and a dark ♀ without data.

B. glandifera, Hübn.—The series of this species includes several examples of the var. *impar*, Warren, from "Cambridge," and of var. *par*, Hübn.

Acronycta aceris, L.—An old specimen, labelled "*candelisequa*, Esp., *infuscata*, Haw.," in which the fore-wings are smooth dark brown-grey with the usual markings only faintly indicated. *A. alni*, L. An almost entirely black ♀ specimen, in poor order "from J. G. Ross" (C.W.D.). *A. leporina*, L. A very beautiful aberration, the ground-colour being pure white without the usual powdering of grey scales, and the black markings almost evanescent. "Combe Woods 1835 for J. C. Dale from D. H. Serrell." A second very similar example, without data, is in inferior condition and apparently much older than the preceding.

Tapinostola extrema, Hübn.—Nine examples, one labelled "From F. Standish, given to him by Mr. Doubleday" (J.C.D.), two "W. Farren's Collection," and one "Wheeler's Sale, 1895" (C.W.D.), "Cambs 1892" and "Baitsbite" at side.

Nonagria neurica, Hübn.—Five specimens, all of old date, of the dark form *hessii*, Bdv., from "Yaxley Fen." *N. sparganii*, Esp. Seven from East Kent, including one fine ♂ and one ♀ "Kent from Downing's sale 1894" (C.W.D.), and one ♂ "From S. Webb 10.12.93 to Lovell Keays, Esq." *N. brevilinea*. Four examples of var. *alinea*, Farn.

Synia musculosa, Hübn.—Five specimens; a very old ♀, with the tips of fore-wings a good deal broken "Lambert, Brighton 1843" (J.C.D.). A very good ♂ "Downing's sale 23.10.94" (C.W.D.), another of the same sex in fair order "From Honble Miss Lushington coll. 1874" (C.W.D.) and a fine ♀ on a modern black pin, "Devil's Dyke, Brighton, Aug. 1899."

Leucania loreyi, Dup.—An old, badly set, but unworn specimen, on a very stout common pin, labelled "Clarke coll.," and "Brighton" at side. *L. vitellina*, Hübn. Four in very good condition; a rather small ♂, "Taken by Mr. Downing nr. Herne Bay, 30 September, 1882"; another ♂, "Lyndhurst, G. Tate 1876 from J. G. Ross" (C.W.D.), and a ♀, "Shoreham, 1876" (C.W.D.). *L. l-album*, L. A ♀ in fine order on a black pin, "Parry, Kent 1873" (C.W.D.), "Canterbury" at side. *L. extranea*, Guén. A ♂ in good condition has two labels, "E. C. Parker, Lyndhurst March 1875" (C.W.D.), and "Lyndhurst from J. G. Ross coll. 1888" (C.W.D.); a ♀, on a modern black pin, is unlabelled. *L. lithargyria*, Esp. A very pretty aberration of the ♀, the fore-wings and fringes of hind-wings being

clear and very pale whitish-ochreous or bone-colour "Rev. A. Matthews' coll." *L. albipuncta*, W. V. Five examples, one rather worn ♀ "Wormald coll. '94," the others from "Folkestone" and "Freshwater." (*L. favicolor*, Barrett is one of the very few species of the British *Macro-Lepidoptera* not represented in the Dale collection).

Pachetra leucophæa, W. V.—A full series, but only one of the older specimens, a ♀ labelled "S. Stevens, Mickleham."

Luperina guenéei, Doubl.—A ♀ in good condition, bearing a printed label cut out of a sale-catalogue "*Guenéei*, I, *vide* Entom. XXVII, p. 25 J. F. Brockholes." *L. dumerili*, Dup. A ♂, also good, on a thick ordinary pin, has the data on one label "Isle of Wight, Rogers, Burney sale" (C.W.D.), and "Sale, Stevens, lot 202, odds and ends."

"*Miana*" *morrisi*, Dale.—Three ♂ examples, somewhat worn and discoloured, labelled at side "Charmouth," stand at the head of the series of *C. arcuosa*, Haw., under the above name. After a very close and careful scrutiny, I can only regard these specimens as a very pallid and immaculate form of *C. arcuosa*, with which species they agree in every particular except in colour. They are certainly quite distinct from the well-known Folkestone insect *Tapinostola bondii*, Knaggs.

Laphygma exigua, Hübn.—The series includes a ♂ labelled "C. W. Dale, Studland, Dorset, 1879" (C.W.D.).

Hydrilla palustris, Hübn.—Five examples (4 ♂, 1 ♀) the latter somewhat damaged in one hind-wing, has a printed label "Mr. Cohen, Wicken." A ♂ is labelled "Mr. Cohen, Norfolk fens 1896" (C.W.D.), and another ♂ "Norfolk Fens, J. G. Ross 1878" (C.W.D.).

Noctua flammatra, W. V.—A ♂ in fine order labelled "H. Rogers, Freshwater, Isle of Wight, Aug. 1880" (C.W.D.). (Cf. C. W. Dale, Ent. Mo. Mag., vol. xvii, p. 135, and "A Guide to the Natural History of the Isle of Wight," p. 410, where Mr. E. R. Bankes states that this specimen "is certainly not British." *N. subrosea*, Steph. A series of thirteen specimens, mostly rather worn; unfortunately the contemporary labels, if any, have been replaced by others in C. W. Dale's handwriting. The best ♂ is from "S. Stevens coll. 1900"; a ♂ and a ♀, "R. Weaver, Whittlesea Mere 1846," and two from "Rev. H. Burney's sale, 1894" (*sic*).

Pachnobia hyperborea, Zett.—A varied series of twelve examples from Shetland and Rannoch, including a rather remarkably light ♂, "George Clark at Rannoch, 1876."

Cerastis erythrocephala, W. V.—Five examples, all in good order; a ♂ on a common pin, "Dr. Livett" (C.W.D.), and "Wells, Novr. 4, '76"; the others (2 ♂, 2 ♀), "Canterbury" at side.

Xanthia ocellaris, Borkh.—A fine ♂ specimen on a modern gilt pin, unfortunately without data.

Dianthæcia compta, Guén.—Two nice examples on modern pins, also without labels, except "Ireland" at side.

Valeria oleagina, W. V.—A rather worn and faded ♂ specimen, lacking the antennæ, on a large old bead-headed pin, is labelled in C. W. Dale's handwriting,

"Fishguard, Pembrokeshire, E. Donovan, July 1800." (In the fine collection of British *Lepidoptera* of the Oxford University Museum, there is a ♀ of this exceedingly rare *Noctua*, also with broken antennæ, but in much better condition than the Dale specimen; it has a modern label, "Coll. Hope, without locality." Cf. Barrett, Lep. British Islands, vol. iv, p. 330).

Hadena peregrina, Tr.—Three specimens on modern gilt pins, all in good condition. A ♂ bears a label "Taken at Freshwater, Isle of Wight 1888" with the addition "from Rev. H. Burney's coll. Rogers" (C.W.D.); another ♂, "Freshwater, H. Rogers" (C.W.D.), and a ♀ has no data. *H. saturata*, W. V. A fine large ♂ on a modern gilt pin "from Rev. H. Burney's coll. sold in 1893" (C.W.D.), also two ♀'s, set low down and in somewhat drooping style, on rather old-fashioned pins, but with no data.

Crymodes exulis, Dup.—Seven very good examples; three of the var. *assimilis*, Doubl. Of these one ♀ is labelled "R. W. 46" (J.C.D.), another ♀ "T. Salvage, Rannoch June 1896" (J.C.D.), the third "Rannoch from J. G. Ross coll. 1888" (C.W.D.). The other four specimens are from "Unst."

Xylina furcifera, Hufn. — A fine series of eleven bred specimens, "Llantrissant" at side. *X. lambda*, Fab. An exceedingly fine ♂, "Ranworth, W. Clare, Sept. 1877" (C.W.D.).

Cloranthia perspicillaris, L.—Two ♂ examples; one in fair condition only, on an old bead-headed pin "Gt. Yarmouth, June, 1837" (C.W.D.), may possibly be the specimen referred to by Barrett (Lep. British Islands, vol. vi, pp. 39, 40), as taken by Mr. C. J. Paget at Yarmouth in "1839." The other in much better condition is labelled as follows, "*Cloranthia perspicularis* (sic.) taken in the New Forest by Lady Florence Herbert who gave it to me herself"; on the label is printed, in red ink, "Mus. M. & M."

Calophasia linariæ, Hübn.—One old and badly pinned specimen, minus the antennæ, but with perfect fringes and otherwise in good order "Woodside, Epping June 1817." Probably one of the original specimens recorded from that locality by J. F. Stephens (Ill. Haust., III, p. 94, pl. 29, fig. 2).

Cucullia scrophulariæ, L.—Five examples, apparently correctly named; one "from W. H. Grigg coll. 1889" (C.W.D.), "Essex" at side.

Plusia orichalcea, F.—Ten examples, large and fine, but none of very recent date, "Wicken" and "Gl. Wootton" at side; a ♂ is labelled "C. W. Dale, G. Wootton July 17th (or 19th) 1872" (C.W.D.) *P. n.*, Hübn. Two fine specimens from "Penzance," one bearing a circular label, "E. Bailey, Penzance, 15.9.94, B." *P. illustris*, Fab. Two ♂ examples, very ancient and without antennæ, but still retaining much of their beautiful colour; they are set in drooping style with the fore-wings very far back, on old clumsy pins. One of these is in fairly good condition and with perfect fringes; both have been labelled by C. W. Dale, "Salisbury Plain by Mr. Spratt from Dr. Leach."

Heliothis armigera, Hübn.—Ten specimens, some very good; a small ♂ and a fine ♀ are labelled "Dr. Cocks 46" (J.C.D.). *H. scutosa*, Fab. A ♀ in very good condition, on a thick old bead-headed pin, has a printed label (cut out of a sale

catalogue) "*Heliothis scutosa* dark var. of female, taken near Carlisle by Mr. Heysham, vide Barrett, E. M. M." (vol. xxv, p. 225).

Chariclea delphinii, L.—Three, all more or less worn; one is labelled "*Chariclea Delphinii*, L., fr. Balchener's Garden brought to me alive Brighton 1857" and "Mus. M. & M." printed on label in red ink; a ♀ in very poor condition, "from old Latham" (C.W.D.), and a much better ♂ without data, have "Windsor" at side.

Acontia solaris, W. V.—Three specimens; a very good, fresh-looking ♂, "Dover, Aug. 24, 1876"; an old and faded ♂ "Mr. Stone, Dover, June, 1825" (C.W.D.), the third, a ♀, "Dover" at side.

Micra paula, Hübn.—A very good example, on a long old pin, "Dr. Cocks, 46" (J.C.D.), "Devon" at side. *M. parva*, Hübn. Three specimens, the best one without data; one has a circular label "1888 E. G. Meek from Harper's sale lot 596," "St. Helen's" at side; the third, rather a poor one, "H. Rogers Freshwater July 1880" (C.W.D.). *M. ostrina*, Hübn. Five examples, mostly good, but unfortunately without data beyond "Freshwater" and "Studland" at side.

Catephia alchymista, W. V.—Two specimens of this great rarity; a ♂ in good condition, "Bembridge, Mr. Harris" (C.W.D.); another ♂, a finer specimen, but very badly set, "Taken by Mr. Harris at Bembridge, I. O. Wight July 1867 see Ent. M. Magazine Sept. 1888." These were probably obtained by C. W. Dale at the sale of the Burney collection in 1893. Cf. Ent. Mo. Mag., vol. xxv, p. 91.

Ophiodes lunaris, W. V.—Two examples, a very fine ♂ "P. Bouchard 1864" (C.W.D.), "Killarney" at side; a ♀, somewhat worn, "Hailsham, Sussex, 28.5.75 see Ent. July 75."

Brephos parthenias, L.—A magnificent melanic aberration of the ♂, the fore-wings above being entirely very deep rich sepia-brown, the reniform stigma and the sub-apical costal blotch being alone faintly traceable in a somewhat darker tint; the hind-wings and body also very dark smooth sepia-brown, the fringes being a little paler. The under-side of the wings is very similar in colour, but of a slightly lighter shade. "From J. G. Ross coll. 1888" (C.W.D.).

Catocala frazzini, L.—Seven specimens, of which the most interesting is a greatly faded ♀ on a very antique pin, which bears a label by C. W. Dale "Mr. Story, Beveridge, nr. Cranborne about 1740." All the others are ♂'s, one on very large old pin "From Mr. Samuel Carter's collection, Manchester"; one in fine order "A. Mercer's sale 1891" (C.W.D.), a fresh and bright-looking example, with a large chip out of right hind-wing, repaired not very neatly from a wing of the same species "Taken by B. Standish resting on paling near Birch Wood, Kent, Sept. 7th, 1827" (C.W.D.); one, worn with the tips of the fore-wings broken "Taken by Mr. W. Harwood at light near Colchester, 1868"; one in fair order "G. Parry, Canterbury 1874" (C.W.D.); and one, much worn, "Hastings" at side.

(To be continued).

Oxford: July 17th, 1909.

NOTES ON THE BRITISH DRAGONFLIES OF THE "DALE COLLECTION."

BY W. J. LUCAS, B.A., F.E.S.

Now that the "Dale Collection," in accordance with the will of the late Charles William Dale, has found a home in Oxford, and is under the care of Prof. E. B. Poulton, it will be possible for entomologists to consult it in the Hope Department of the University Museum. To assist the number (still small, but nevertheless increasing) of those who are interested in the British *Odonata*, the following notes of the species contained in the collection have been prepared.

To look at, this part of the collection is not prepossessing. The specimens are often badly set, and in poor, to extremely poor, condition; but as regards historic and scientific interest their importance is of the first order, though one would have liked to find them with a cared-for appearance nevertheless. The majority of the specimens bear labels of some kind—often two, or even more—but still there is unfortunately a considerable number without any sign of history whatever. This is a pity, for James Charles Dale, the father of the late owner, and John Curtis were fellow workers and collectors, and there is little doubt that the figures* in Curtis' "British Entomology" are taken as much from Dale's insects as from his own, and to this is due to some extent the importance of the "Dale Collection."

In this paper the *Anisopterides* are passed in review, the *Zygopterides* being reserved for a later occasion. The former are contained in seven and a half drawers, and comprise the respectable total of 168 insects. All are here referred to, although it may be possible to say nothing about them except the negative fact that they are unlabelled. The sex is given in every case. (J. C.) means that the label is in J. C. Dale's handwriting, (C. W.) in that of his son; "filled in" is added if the label is partly printed. There may of course be now and then a little doubt as to the identity of the handwriting, but there usually is not; that of C. W. Dale is at times barely decipherable. Sometimes a label is pinned at the side of an insect; this is indicated by the addition of "at side." In one or two cases these side labels are apparently incorrect. The numbers in brackets give the order in which the insects stand in the cabinet.

Commander J. J. Walker has been kind enough to check the many numbers and dates, and to assist me in recognising the handwriting of both J. C. and C. W. Dale, though that of the latter could not easily be mistaken.

* The dragonflies, however, are three only.

Libellula depressa.—There are six specimens, two males (1, 2) and one female (4) being without labels. A female (3) is from Whittlesea Mere, July, 1837 (J. C. in red ink). A female (5) bears three labels, Herne Bay, 1842 (J. C.), *depressa* ♀ (J. C.), and Glanvilles Wootton (at side); as does also another female (6), W. Mere (J. C. in red ink), July 16, 1837 (J. C. filled in), and Peterborough (at side). In the case of No. 5, the first and third labels do not agree.

Libellula quadrimaculata.—Four males, (7) Wn. chester (?) 1843; (8) Middlemarsh (J. C. in pencil), and May 11, 1819 (J. C. filled in); (9) Scotch, 1847; (10) Chant, 46.

L. q. prænubila, var.—Two females, (11) Parley (J. C. in pencil); (12) Whittlesea (J. C. in pencil), and June 26, 1818 (J. C. filled in).

Libellula fulva.—Six specimens, of which a male (13) and a female (15) are unlabelled. A male (14) is from Hurne (J. C. in pencil), July 5, 1837 (J. C. filled in); another male (16) has Parley Heath (at side); while a third (17) is labelled Ireland, R. W.* 1849 (J. C.), and Dingle (at side). A female (18) is dated May 19, 1819, and has Hurne (at side).

Libellula cancellata.—Again six specimens, three males and three females. Of the males (19) has a blank pink label, (21) has Chant, 46, while (23) has June 24, 1842 (J. C. filled in), and Whittlesea Mere (at side). The three females each bear two labels (20) Ent. Club, and in addition, from C. W. D. 29/1/1877 (C. W. in pencil); (22) Farr, and H. Y.; (24) Aug. 16, 1837 (J. C. filled in), and Huntingdon (at side).

Libellula cærulescens.—Seven examples, one female (28) bearing no label. Of the rest five males are thus described: (25) Cosmore Common, July, 1839 (J. C.); (26) July 1, 1839 (J. C. filled in), and Middlemarsh (at side); (27) Scotch, 1847 (J. C. probably), and N. B. (at side); (29) Ireland, 1849, R. W. (J. C.), and Ireland (at side); (31) Land's End, Augst, 1864 (C. W.), and Land's End (at side). The seventh, a female (30) is from Boscombe Chine, June, 1846 (J. C.).

Libellula flaveola.—This is one of the more interesting species, owing to the doubt as to whether it breeds in this country, the uncertainty of its appearance and perhaps also the paucity of females pointing to its being a migrant. The cabinet contains seven examples, six males and one female, one of the males (35) being unlabelled. So few British females are known, that this well authenticated example (34) is of considerable importance. Two males (32, 33) and the female (34) apparently belong to the same catch, they bear labels (32) Whittlesea, July 16, 37 (in MS.); (33) *basalis* (J. C.), and July 16, 1837 (printed label filled in); (34) Whittlesea (J. C. in red ink), July 16, 37 (J. C.), and in pl.† July 16, 37, Stilton Fen (J. C.). No. 36 is labelled Ent. Club, (37) has two labels, *basalis* (Stephens' writing probably), and Mr. Stephens. (38) has Whittlesea Mere (at side).

Libellula striolata.—Twelve specimens, one male (40) and two females (47, 49) being unlabelled. The other males are—(41) Charmouth, Oct., 67 (C. W.); (43) Constantine, 1873 (printed label, 73 filled in); (48) Charmouth, Sept^b. 1845 (J. C.), and Sep. 3, 1845 (J. C. filled in); (50) labelled as the last, but with

* Richard Weaver, probably.

† *In pluribus* (?).

"Glanvilles Wootton" (at side), this side label being probably the wrong one. There are five females with labels—(39) W. Mere, 1842 (J. C. probably); (42) with four labels, 1014 (printed), Dale, Apr 1833 (on the reverse $\frac{27}{2}$), Dale, and I. of Iona, Aug 4 1825; (44) Nov 19 1821 (J. C. filled in), and Glanvilles Wootton (at side); (45) Constantine, 1873 (printed label, 73 filled in); (46) *vulgata* (J. C. probably). The date of No. 44, presumably that on which it was captured, is the latest with which I am acquainted; I have taken the species myself on November 14th.

Libellula meridionalis.—Both specimens of this "casual" are males without record of date or place of capture. No. 51 is described as *meridionalis*, ♂ (possibly in J. F. Stephens' writing). No. 52 is labelled *meridionalis*, De Selys (J. C.), and Evans (J. C.).

Libellula vulgata.—Of this species, which is perhaps a "casual" like the last, the Dale Collection contains four specimens—two males (53 and 54) without labels, and two females (55 and 56). No. 55 is described as "*L. vulgata* ♀ adulte," and No. 56 is labelled, "from Mr. Harrison of Hull, 1837" (J. C.'s writing, almost certainly), and is of special interest as being the earliest of the five British specimens of which we possess records.

Libellula fonscolombii is yet another "casual," of which the collection contains three specimens, two—(57) a male, and (58) a female—being old and unlabelled. No. 59, a male, is one of those captured by Chas. A. Briggs, in Surrey, 3 June 1892 (C. A. B.'s label). A second label gives "Fleet Pond, Surrey" (C. W.), which is a mistake for "Boldermere, or Hut Pond," near Ripley, where Mr. Briggs made his captures. Fleet Pond, moreover, is in Hampshire.

Libellula sanguinea.—There are seven examples—six males and one female, which probably represent fairly the proportion in which the sexes are usually captured. No. 60 bears record, Whittlesea (J. C.); (61) Aug. 15, 1837 (J. C. filled in); (62) in pl. Aug. 15/37, Holme, Hunts. (J. C.), and Whittlesea (J. C. in red ink); (63) unlabelled; (64) Whittlesea Mere, 1825, Mr. Bently (J. C.); (65) Whitwell (J. C.), Aug. 16, 1837 (J. C. red label, filled in), and Whittlesea (at side). The single female (66) is labelled—Aug. 15/37, Hulme, Hunts. (J. C.), and Hunt-ington (at side).

Libellula dubia.—Seven specimens, of which two males (68, 69) and one female (71) are unlabelled. A male (67) is described as "H. D. 1843. Epping," and is evidently one of Doubleday's insects; but it is extremely unlikely that it was taken at Epping. Another male (70) is from Delamere, Ches. (C. W.). A female (72) bears the date Aug. 11, 1837 on a yellow label with J. C.'s figures, while another female (73) has a yellow label of the same sheet as the last, but not filled in. The last insect has Yorkshire (at side), which no doubt refers to the previous insect also.

Libellula scotica.—Of this species there are no less than fourteen examples, of which two (75, a male, and 86, a female) are in "teneral" condition, and five (75, 77, 81, 85, 87), three males and two females, are without labels. The rest are described as follows:—a male (74) W. Mere (J. C. in red ink); a female (76) Cooke (J. C. probably); a female (78) W. Mere (J. C. in red ink); a female (79) June 28, 1818 (J. C. filled in); a female (80) Purbeck (at side); a male (82) Gl.

Wootton (printed), and Glanvilles Wootton (at side); a male (83) July 11, 1842 (J. C. filled in); a female (84) Cooke (J. C. probably); a female (86) Scotd.—R. W. (J. C. probably).

Cordulia curtisii.—No doubt the five examples of this species are the most interesting in the whole collection, as J. C. Dale is the author of its name. His original description is to be found in Loudon's Magazine of Natural History, Vol. ii, p. 60. In connection with this he writes, under date, Sept., 1833:—"On June 29, 1820, I discovered a new *Cordulia* on Parley Heath, Hampshire. It is one of the finest insects I have ever found; and I had proposed to name it after a certain friend, but objection has been raised to its bearing his name 'he not being the captor.' As it has remained a nondescript up to this time, and is unnoticed, so far as I can find out, by Van der Linden, Charpentier, and other writers, I now venture to describe and name it after a friend whom I saw capture it." There is no specimen in the collection bearing the date 1820, though No. 89, a mature female with "Parley Heath" (at side), may be of that date. The other specimens with their labels are:—a female (92) July 16, 1823 (J. C. filled in), and Parley Heath (at side); a male (88) June 8, 1831 (J. C. filled in), and Parley Heath (at side); a male (90) C. W. Dale, Iford, June 10, 1892 (C. W.); a female (91) Bournemouth [in Hants.*], 1903 (C. W.), and Bournemouth (at side). As both sexes of the species were described by J. C. Dale in September, 1833, we must look upon all the specimens he then possessed as co-types. Very possibly also any examples of earlier date than this in the "Curtis Collection," now in the Victoria National Museum at Melbourne, may have been passed under review when the description was being made. The female is figured in Curtis' "British Entomology," pl. 616, and the author speaks of one specimen on June 8th, 1831, captured by himself—presumably the one figured, and also presumably taken when in company with J. C. Dale, who also has a specimen of that date.

Cordulia aenea.—Five specimens:—a male (94) Chant, 46; and four females, (93) May 24, 1821 (C. W. filled in); (95) Thorne Moor, Mr. Beckitt (in red ink, C. W. probably); (96) H. D. 1843 (probably H. Doubleday's writing); (97) Chant, 46.

Cordulia arctica.—Five specimens, one of which, a female (101), has no label. A male (98) is labelled "Irish" in pencil, probably in C. W.'s writing, and a female (99) is similarly labelled, but has in addition "Killarney" at the side. A male (100) is labelled "Scotch," in pencil, probably in C. W.'s writing, and a female (102) has "Scotland" at the side. Of these the Irish examples are the most interesting, as the species was scarcely to be expected from Killarney. Possibly, however, there are other dragonfly surprises in store from the south-west of Ireland.

Cordulia metallica.—Again five examples, the earliest of them being comparatively modern. A male (107) has a label "Dr. White, June, 1870" filled in by C. W., and "Strathglass" at side (C. W.). The other four, also males (103—106), were taken by J. J. F. X. King at Guisachan, in August, 1899, and all bear his typed label to that effect.

Gomphus vulgatissimus.—There are six specimens, all but one rather sparsely labelled. A male (108) has "Lydlinch" at side; another (109) simply bears the

* The words within [] are a guess only, the writing being practically indecipherable.

number "4," a third (110) has H. D. 143 (J. C.); and a fourth (111) June 11, 1820 (J. C. filled in). A female (112) has H. D. 1843 (J. C.); another (113) has May 11, 1819 (J. C. filled in), and Parley Heath (at side).

Cordulegaster annulatus.—Of this species there are eight examples, of which two males (118, 120) are unlabelled. The remaining six bear the following inscriptions:—a male (114) Mus. Cheldr.; a male (115) Dale; a male (116) June 10, 1817 (J. C. filled in); a female (117) Glanvilles Wootton (at side); a female (119) Chant, 46; a female (121) Glanvilles Wootton (at side).

Æschna pratensis.—The examples of this species are in two groups, some being placed in Drawer 4, others in Drawer 5. There are eight in all, of which a male (125) has no label. The rest are labelled as follows:—a male (122) H. D. 1843 (J. C.); a male (124) Chant, 46; a female (123) H. D. 1843 (J. C.); a female (126) June 29, 1818 (J. C. filled in), and Parley Heath (at side); a male and a female (135, 136) Kirkman's Sale, 1847 (J. C.); a female (137) Parfitt, Exeter, 1858, and Devonshire (at side), also *aspis* ? var. (at side).

Anax formosus.—Eight specimens of this fine insect, of which one male (127) bears no inscription. The rest are labelled as follows:—a male (128) May 23, 1831 (J. C. filled in); a male and a female (129, 133) Chant, 46; a male (131) *Æshna* (in pencil); a female (130) July 28, 1819 (J. C. filled in), and Parley Heath (at side); a female (132) Ent. Club; a female (134) Glanvilles Wootton (at side).

Æschna mixta.—This insect, not long since considered so scarce as British, is well represented by seven rather fully labelled specimens:—a male (140) Black Pond, 7.9.01 (W. J. L.)*; a male (141) Curtis. Dover (in pencil), and Dover (at side); a female (138) Ent. Club, and W. Christy Jersey; a female (139) Ent. Club; a female (142) Yarmouth, Pagett. f. Farr, June, 1849 (J. C.), and Suffolk (at side); a female (143) Walton, 1844 (J. C.); a female (144) Gl. Wootton, July, 1807 or 8? (J. C.), July c. 1807 (at side, J. C. filled in), also Glanvilles Wootton (at side).

Æschna borealis.—Four specimens, one female (145) being without a label. The other three are from Scotland, as would be expected. They are:—a male (146) Jul. 1854 (J. C. filled in), and Scotch. R. W. 54 (J. C. in pencil); a female (147) July, 1847 (J. C. filled in), and Scotch. 1847. Hodgkinson (J. C.); a female (148) Rannoch, June, 1896 (C. W.), and Rannoch (at side).

Æschna cyanea.—This common species is represented by four examples only, one female (149) bearing no label. The others are:—a male (150) Herne Bay, 1842 (J. C.); a female (151) Kirkman's Sale, 1847 (J. C.); a female (152) Glanvilles Wootton (at side).

Æschna juncea.—Eight specimens, two only being males. The males are (153) Jul. 1846 (J. C. filled in), and Scotld. R. W. 1846 (J. C.); (160) Loch Swilly, Donegal, Thos. Lighton, Esqr. (? J. C.'s writing), and IRELAND (at side). Females:—(154) Jul 21, 1825 (J. C. filled in), and 735, also Scotland (at side); (155) Woolmer Fo. 1842 (J. C.), and Jul 9, 1842 (J. C. filled in); (156) Rannoch, June, 1896 (C. W.), and Rannoch (at side); (157) Penzance, E. R. Dale, Aug., 1864 (C. W.), and Penzance (at side); (158) British, Dr. Leach (J. C.); (159) Manchester, 1842 (J. C.), and Lancashire (at side).

This is one of the author's Surrey specimens.

Æschna rufescens.--The collection contains four only of this local Fen species:—a male (162) Norfolk, July, 1905 (C. W.), and Norfolk (at side); a male (163) June 28, 1818 (J. C. filled in); a female (164) Aug. 5, 1824 (J. C. filled in), and Whittlesea Mere (at side); also a male (161) with a label bearing 11 or II (?).

Æshna (sic) grandis.—Four specimens, two, a male (165) and a female (166) being unlabelled. The other two are:—a male (167) Parley Heath (at side); a female (168) Xchurch, and Christchurch (at side).

(To be continued).

NOTES ON THE BRITISH DRAGONFLIES OF THE "DALE COLLECTION,"
(II).

BY W. J. LUCAS, B.A., F.E.S.

(Concluded from Series 2, Vol. xix, 1908, p. 203).

Reprinted from "The Entomologist's Monthly Magazine," 2nd Series, Vol. xx.

There remain to be reviewed the *Zygopterides*, that is, those dragonflies in which the fore- and hind-wings are more or less alike. They are contained in three and a half drawers, and comprise no less than 193 insects. These, with the *Anisopterides* already treated, bring up the total in the "Dale Collection" to 361.

Calopteryx virgo.—There are nine specimens, a male (171), a male (173) with uncoloured wings and greenish body, and one female (175) being without labels. A male (169), has a blank green label, and Walcott. 1843 (J. C.). A male (170) is from Cosmore Comp., 1843 (J. C.). A male (176), with uncoloured wings and greenish body, is labelled H. D., 1843 (J. C.), while another (177) of similar appearance has "anceps Ste. v. Vesta" (at side). A female (172) has two labels—New For., 1842 (J. C.), and Jun. 1842 (J. C. filled in),† while another (174) has Glanvilles Wootton (at side).

Calopteryx splendens.—Again there are nine specimens, a male (181) and a female (183) being unlabelled. A male (178) and a female (180), each bear a blank green label, and Walcott, 1844 (J. C.). A male (179) has a blank green label, and Belfast T R., 42 (J. C. red ink), another (182) has a small blank pink label, and W. Mere, 1842 (J. C.), a third (184) is labelled Powerscourt (printed), and Holwell, June, 1863 (J. C.). A female (185) has a printed label "Glengarriff," and another (186) has Glanvilles Wootton (at side).

Platynemis pennipes is represented by eight examples, two females (189, 190) and one male (193) being without labels. A male (187) is from Parley 1849 (J. C. in pencil). The rest are females:—(188) has, 20/5/56, Natal, 8.11—, and Holwell (at side), (191) has Chant 46, (192) has $\frac{7.3.3}{1}$ (J. C.), (194) has Parley Heath (at side).

Lestes sponsa.—There appear to be twenty examples of this insect, which C. W. Dale apparently had a little difficulty in correctly determining. Three females (200, 201, 214) bear no labels. Two males (195, 213) and two females (215, 216) are labelled Norfolk July 1905 (C. W.), and two females (202, 217) are labelled in the same way, but have in addition, Norfolk (at side); the last of these females appears to have something wrong with its anal appendages. Of six males (196) is labelled Chant 46; (197) New For. 1844 (J. C.); (198) July 2 (or 21) 1844 (J. C. filled in); (210) Aug. 1846 (J. C. filled in), and Killarney 1846 Fisher (J. C.); (211) Branksome Chine nr. Bournemouth Ag. 1865 (C. W.), and Bournemouth (at side); (212) Doubleday (J. C.). A female (199) has three labels:—New For. 1844 (J. C.), Jun. 1844 (J. C. filled in), and New Forest (at side). Besides these there are three examples under the name of *Lestes viridis*,

but as the name is reversed Dale evidently recognised that they did not belong to that species: they are—a male (207) Dr. White Jun. 1870 (J. C. yellow label filled in), a female (208) blank yellow label, and a female (209) with no label. Further, under *Lestes nympha* appears a male (219) which seems to be *L. sponsa*; it bears a blank red label, and Whittlesea (J. C.).

Lestes virens, *L. barbara*, *L. viridis*.—Of the first species there are two examples. A male (203) has two labels, one "No 25 *Lestes virens*, Chp. ♂," the other simply "56," and a female (204) labelled, "*Lestes virens* ♀." There is a male (205) of the second species labelled, "*Lestes barbara* ♂." The third species is also represented by a male (206) labelled, "*Lestes viridis* ♂." The labels of the last three insects are in very old writing belonging to the same hand, but not J. C. Dale's. It is quite possible that they are foreign examples put in the collection as types of the three species, which were once considered to be British. At any rate there is nothing to shew that they are British examples of insects that apparently do not now belong to our fauna, if they ever did within the entomologically historic period.

*Lestes nympha**.—Two males (218, 220) and one female (221) are unlabelled. A female (222) labelled H. D. 1843 (J. C.), appears to me of somewhat doubtful identity; a second female (223) bears two labels, July 19: 1819 (J. C. filled in), and Eltysley Cambs. (J. C. ?); a third female (224) also bears two labels, forcipula Ev.† (J. C. ?), and Cambridgeshire (at side). No. (219) is referred to under *L. sponsa*.

Agrion naias.—Of this species there are seven specimens, a male (225) being the only one without history. The rest are labelled as follows:—a male (226) Farr. 1844 (J. C.), and H. Y. (J. C.); a male (227) Doubleday (J. C.); a female (228) Sutton Broad, Norfolk July 1905 (C. W.), and Norfolk (at side); a female (229) Weaver (J. C.); a female (230) Whittlesea Mere Mr. Whitwell. 1844 (J. C.), and 11; a female (231) H. D. 1843 (J. C.), and Essex (at side).

Agrion armatum.—The name is reversed, shewing that C. W. Dale recognised that the eight insects above it were wrongly named. All in fact seem to be *Agrion pulchellum*, except (233), which is very teneral and may be *A. puella*, and (234), which is so dilapidated that one would scarcely like to assign it a name at all. The eight insects are labelled as follows:—a male (232) Whittlesea 1843 (J. C.); a male (233) var. like *hastulata*? Gl. Wootton (J. C.); six females (234–9) Norfolk July 1905 (C. W.). The last has in addition Norfolk (at side), no doubt intended for all six. (236, 237, 239) are of the blue form, while (238) has a tendency in that direction.

Agrion hastulatum.—Under this name there are in the cabinet six insects: the last, however (245), is a male example of *E. cyathigerum*. The male (242) has no history: the others are labelled as follows:—a male (240) Scotld. R. W.‡ (J. C. red ink); two males (241, 3) Mus. Childr.; a female (244) Scotld. R. W. (J. C. red ink), and a blank green label. These specimens are of great interest, since the species was rediscovered on the River Spey by Colonel Yerbury in 1900.

Agrion cyathigerum.—There are eighteen insects standing in the cabinet to

* Now known as *Lestes dryas*.

† Ev. is no doubt a contraction for Evans.

‡ Richard Weaver's captures apparently were made in Sutherland in 1842 (*in litt.*, C. W. Dale, 3 Feb., 1904).

this name, but of these, two females (252, 3) seem to me to be *A. puella* and *A. pulchellum* respectively: being, however, without history of any kind, they are unimportant. Three males (257, 259, 263), and a female (254) are unlabelled. The remaining twelve are:—a female (246) *brunnea* *Ev.*; a female (247) *brunnea* *Ev.*, and *Evans* (printed); a male (248) Thorne (J. C. red ink), *cyathigerum* (J. C.), Aug 11: 1837 (J. C., yellow label filled in); a male (249), R. C. Pond Gl. Wootton (C. W.); a male (250), July 9, 1842 (J. C. filled in), Wolmer (J. C.); a female (251) 16 (printed), and a blank yellow label; a female (255), May 31, 1842 (J. C. filled in), Glanvilles Wootton (at side); a male (256), Norfolk July. 1905 (C. W.); a male (258), Portland, and Portland (at side); a male (260) *cyathigerum* (J. C.?), 31/5/42 (J. C.); a male (261), July 6, 61 (J. C.?), July 17 1861 (yellow label filled in), and a small blank yellow label; a male (262), Parley (J. C.). In addition with this species I should class:—a male (245) placed with *A. hastulatum*, with a blank red label, and Sutherland (at side); a female (285) unlabelled; and a male (290) labelled Sutton Broad July 1905 (C. W.); both placed with *A. pulchellum* in the cabinet.

Agrion puella.—Sixteen insects are placed as belonging to this species; two, however (270, 276), I should assign to *A. pulchellum*. Of the remaining fourteen two males (265, 273) and three females (275, 277, 278) are without labels. The rest are labelled as follows:—two males (264, 266), Whittlesea (J. C. red ink), and a blank pink label; a male (267) W. Mere (J. C. red ink); a male (268) Whittlesea 1844 (J. C.), and a blank pink label; a female (269) Marl-pits New For. July 4th, /44 (J. C.), ♀ *furcatum*?, and July 4, 1844 (J. C.); a female (271) June ♀ 1, 1844 (filled in), 6/1/44 (J. C.), *furcatum*? ♀, and Glanvilles Wootton (at side); a male (272) Whittlesea (J. C.? red ink) and a blank pink label; a male (274) ♂ *furcatum* *Chp. int* ♂ *rufescens* Leach *M. B.*; a female (279) Gl. Wootton 1842 (J. C.).—In addition two placed with *A. pulchellum* I consider belong here:—a male (280) Freshwater 1880 (pink ink), Freshwater (at side); and a female (287) Bentley (J. C.), and Glanvilles Wootton (at side). (252) placed with *A. cyathigerum* has already been referred to.

Agrion pulchellum.—Sixteen insects stand to this name, but (280, 287), as already mentioned, I should assign to *A. puella* and (285, 290) to *A. cyathigerum*. Those appearing with the reversed name *A. armatum* have already been discussed. The remaining specimens are:—three males (281, 2, 3) *puella* *Ev* (red ink); a female (284) July 1905 (C. W.), Norfolk (at side); a female (286) *cyathigerum* *Ev* *puella* *Ev*; a male (288) *puella* *Ev*. (red ink); a male (289) *lunulatum* *Ev.*; a female (291) Whittlesea July 1844 (J. C.), and a blank pink label; a female (292) H, and *interruptum*; a female (293) fr. Farr (J. C.); a female (294) N, and a blank pink label; a female (295) with four labels—a blank pink one, Whittlesea I. H. 42, Whittlesea Mere Whitwell 1845 (J. C.), and *interruptum* ♀. It must be borne in mind that this species and *A. puella* are very closely allied, by some indeed considered scarcely distinct. Consequently identification, especially of poor specimens, is not always satisfactory.

Agrion mercuriale.—Of the eight examples, four males (296–9) are unlabelled, but the last has New For (at side), and this is evidently intended to refer to all four. A male (300) has June 17 1832 (filled in), and Winchester (at side); another male (301) has June 2 1837 (filled in), and ♂ Cosmore Comⁿ 1837

(J. C. red ink); a female (302) has Cosmore (J. C. red ink); while another female (303) has July 6 1844 (filled in), New Fo. 1844 (J. C.), and Cosmore Quag (at side). The last four are of interest since the New Forest is the only certain locality for the species at the present time.

Agrion minium.—There are eight specimens, a female (304) and two males (305, 308) being without labels. The others are:—a male (306) Chant 46; a male (307) Mus. Childr., and minius; a female (309) W. Mere (J. C. red ink), a blank pink label, W: Mere 1842 (J. C. red ink), and minius ♀; a female (310) $\frac{2.3.3}{3.3}$, and a blank pink label; a female (311) Lancashire (printed), Whittlesea (at side); (310) is of the form *melanotum* (*æneatum*), while (311) has a tendency in the same direction.

Agrion tenellum.—There are sixteen representatives of this interesting little species, but four males (313, 314, 316, 317) and three females (319, 320, 322) are without inscription. Two females (312, 321) simply bear the name "rubellum," while another (315) has "rubellum ♀." The others are labelled as follows:—a male (318) Chant 46; a female (323) nr. Racecourse New Fo. 1844 (C. W.), and var. γ? *Chp*?; two females (324, 326) 1842 (J. C.), and a blank red label; a female (325), July 15 1839 (J. C. filled in); a female (327) ♀ rubellum v. h. rar. ? ♀ *ezonata* *Step*? (J. C.), and a blank green label. (319) is of the form *erythrogastrum* (*rubratum*); (322, 324, 325, 326, 327) are of the form *melanogastrum* (*æneatum*), while (323) approaches it; (322) is in the feneral state.

Agrion elegans.—To this name there stand seventeen insects, of which three males (330, 338, 339) and three females (329, 331, 342) are unlabelled. The remainder bear labels as follows:—a male (328) Norfolk July 1905 (C. W.); a male (332) and a female (343) Little; a female (333) Walcott 1844; a female (334) 31/5/12 (J. C.), and May 31 1842 (J. C.); a female (335) Belfast T L 42, a blank green label, a printed label with "Sir C. R. Lighton" on one side and "of St. John's" on the other; a female (336) Norfolk July 1905 (C. W.); a male (337) a blank blue label; a male (340) H, and *zonata*; a male (341) 31/5/42 (J. C.), and Glanvilles Wootton (at side); a female (344) Whittlesea (J. C. red ink). (335 and 336) are of the form *rufescens*; while (342, 343) look a little like large examples of *A. pumilio*. Amongst the specimens of the last named insect, *A. pumilio*, there are also two examples of this, the common species—a male (348) Land: End Aug. 1864 (C. W.); and a female (349) Cornwall.

Agrion pumilio.—Omitting the two specimens of *A. elegans* (348, 349), there are still fifteen representatives of this interesting little dragonfly; but six males (345, 346, 347, 351, 356, 358) are without history. The others are labelled as follows:—a female (350) Land: End Aug. 1864 (C. W.), and Land's End (at side); a female (351) New Fo. (J. C. red ink), and New Forest (at side); two females (352, 355) and two males (357, 360) 1842 (J. C.); a female (353) 1842 (J. C.), and Dorchester (at side); a male (359) with three labels, July 3, 1844 (J. C. filled in), *pumilio*, and New Forest (at side); a female (361) also with three labels, Holnest (J. C.), Aug. 1809 (filled in), and Glanvilles Wootton (at side). (350, 351, 352) are of the form *aurantiacum*.

28, Knight's Park,
Kingston-on-Thames:
March 1st, 1909.

A NEW ABERRATION OF *EPHYRA PENDULARIA*, L.

BY F. C. WOODFORDE, B.A., F.E.S.

Reprinted from "The Entomologist's Monthly Magazine," 2nd Series, Vol. xxi.

In 1908 I obtained batches of ova from two bred females of *Ephyra pendularia*, L., ab. *subroseata*, mihi. One of the females was paired with a bred male, the other with a very worn wild male. No partial emergence took place in August of that year though about eight of the pupæ were discovered dead in September with completely developed imagines inside the pupa case. In May and June, 1909, emergence took place, and over thirty perfect imagines were produced. The majority were ab. *subroseata*, but eleven were of a coloration I have never seen before. They differ from ab. *subroseata* (of which aberration a description may be found in the "Entomologist," vol. xxxv, p. 275) as follows:—The central portion of the fore-wings is pale ochreous instead of being red. The hind-wings are entirely grey. In other respects the form closely resembles ab. *subroseata*. The ocelli are distinct on both sets of wings. The second line, consisting of very distinct black dots, is continued through both wings, and is followed by a distinct whitish band. The cilia are pale grey preceded by a well-marked dark grey line. This form is very distinct from ab. *subroseata*, and I would suggest as a name for it ab. *subochreata*. Unfortunately, as it has turned out, I fed up the larvæ of the two batches together and so am in ignorance of the male parentage of the new form, as to whether it was a bred *subroseata*, or the worn wild male. The latter was of the *subroseata* type, but the colour of the central part was so faded as to be unrecognisable, and it *may* have been pale ochreous. It was taken in North Staffordshire to which district I believe the form *subroseata* is confined. Last June I paired two of the ochreous form and now have pupæ whose emergence is due next month.

The type specimen of the new form I have given to Prof. Poulton, and it is now in the Collection in the Hope Department, Oxford University Museum of British *Lepidoptera*.

Market Drayton:

April, 1910.

SECOND SUPPLEMENT

TO THE

PRELIMINARY LIST OF THE COLEOPTERA OF THE OXFORD DISTRICT,

Published in the Report of the Ashmolean Natural
History Society of Oxfordshire for 1906.

By JAMES J. WALKER, Hon. M.A., R.N., F.L.S.

Two years have elapsed since the publication in the Report of the Ashmolean Natural History Society for 1907 of the First Supplement to the Preliminary List of *Coleoptera* of the Oxford District. During that interval, the investigation of our exceedingly rich and interesting beetle-fauna has been pursued steadily, with the result that the number of additions to the list of species already known is I trust sufficient to justify the compilation of the present "Second Supplement." These additional species include a large proportion of forms of rare and local occurrence, especially in the family *Staphylinidæ*. This extensive and difficult section of the *Coleoptera* has been, as previously, closely studied and worked by my friend Mr. Joseph Collins of the "Hope Department," and his efforts have resulted in a large number of very interesting additions to the local list, in many cases examined and confirmed on the authority of Mr. G. C. Champion. Some very good contributions have also been made by Messrs. W. Holland and A. H. Hamm, and by Prof. T. Hudson Beare, Mr. H. St. J. Donisthorpe, Mr. P. Harwood, and Mr. J. R. le B. Tomlin, in occasional visits to the district. Of course it is hardly to be expected that additions to the list of species occurring in the district (which may now be considered as on the whole pretty well worked) will come in as rapidly in the future as in the past. It is only fair to say, however, that one or two localities of old repute near Oxford, which are now closed to Naturalists in general, might well be expected to yield many rare and interesting additional species of *Coleoptera* as well as of other

Orders of Insects, were it possible to obtain the requisite facilities for working in them.

ORDER COLEOPTERA.

FAMILY Carabidæ.

- [*Chlœnius nigricornis*, F., var. *melanocornis*, Dej. This well-marked variety was taken by Mr. J. Collins in flood-refuse at Sparsey Bridge, Water Eaton, in company with the type-form, 1st May, 1908.]
- **Harpalus picipennis*, Dufts. One example taken at Tubney by Mr. H. St. J. Donisthorpe, July 2nd, 1900. A very local coast insect, which has been found inland on exceedingly few occasions.
- **Trechus micros*, Herbst. "Sparingly, in several localities" (J. W. Shipp, Ent. Mo. Mag. 1893, p. 90). Mr. Collins and I found it not rarely on the Cherwell Banks, in rejectamenta after the great flood at the end of April, 1908.
- **T. secalis*, Payk. In river-refuse at King's Weir, sparingly, 17th July, 1909.

FAMILY Dytiscidæ.

- **Hydroporus rivalis*, Gyll. In small stream near Islip, one example, 9th May, 1909 (*J. C.*).
- **H. discretus*, Fairm. In Bayswater Brook near Elsfeld; rare, 1st September, 1909.
- ***H. marginatus*, Dufts. One example of this rare species taken in a water-hole at Tubney, 31st July, 1909.
- Agabus guttatus*, Payk. In running water near Wytham, not rare, March, 1908 (*J. C.*).

FAMILY Hydrophilidæ.

- Limnebius nitidus*, Marsh. Among wet gravel near Binsey; rare, 20th May, 1908.
- **Helophorus porculus*, Bedel. This comparatively recent addition to the list of British Coleoptera is found not rarely at Tubney, Wytham Park, &c. in company with the closely allied *H. rugosus*, Ol.
- **H. arvernicus*, Muls. In river-refuse at King's Weir; one specimen, 17th July, 1909.
- **Hydræna nigrâ*, Germ. In running streams, clinging to stones, not rare; first taken by Mr. J. Collins at Water Eaton, 12th April, 1908.
- **Cercyon terminatus*, Marsh. In manure-heap at Summertown; not rare, 11th October, 1909.
- C. lugubris*, Payk. In wet moss, Yarnton, common (*J. C.*).

FAMILY Staphylinidæ.

- **Aleochara fumata*, Grav. One example in a grass-tuft on the Isis bank near Wytham Park, 30th January, 1909.
- [***A. crassiuscula*, Sahlb. To this recent addition to the British *Coleoptera*, the insect recorded by me in the "Preliminary List," p. 61, as *A. marcus*, Gyll., must be referred. I found it again, not uncommonly, in rather dry manure-heaps near Summertown, 20th September, 1909, and on several subsequent occasions.]
- ***Microglossa marginalis*, Gyll. A fine series taken in a starling's nest in a hollow elm tree near Water Eaton, 2nd August, 1908 (*J. C.*).

- **M. gentilis, Märk.** In an old (? starling's) nest in a felled elm at Ferry Hinksey, rare, 12th April, 1909; also singly near Tubney in company with the ant *Lasius fuliginosus*, 29th May, 1909.
- *Oxyopoda exoleta, Er.** In rabbit burrows at Tubney, 6th September, 1908 (*J. C.*).
- *O. lentula, Er.** In pond-refuse, Wood Eaton, 10th July, 1908 (*J. C.*); also taken by myself at Yarnton.
- *O. umbrata, Gyll.** In wet moss at Cothill, 25th April, 1909 (*J. C.*). I have taken it by sweeping at Wytham Park, October, 1909.
- *O. nigrina, Wat.** In haystack-refuse at Yarnton, 27th June, 1909, one specimen (*J. C.*).
- O. hæmorrhœa, Sahlb.** Tubney, in company with *Formica rufa*; not rare (*J. C.*).
- *O. annularis, Sahlb.** In wet moss at Cothill, one example, 2nd May, 1909 (*J. C.*).
- **Thiasophila inquilina, Märk.** This rare species has been taken by Mr. A. H. Hamm in company with *Lasius fuliginosus* at Shotover Hill, 5th September, 1908.
- *Ocyusa incrassata, Muls.** Under bark at Hen Wood, one example, 17th August, 1908 (*J. C.*).
- *Ilyobates nigricollis, Payk.** In flood-refuse at Sparsey Bridge, one example, 3rd May, 1908 (*J. C.*).
- **I. propinquus, Aubé.** Sparsey Bridge, several examples in flood-refuse, 2nd May, 1908.
- **Calodera nigrita, Mann.** In grass-tuft near Yarnton, 16th January, 1909; taken rather freely in the same spot at end of March, and at Bayworth, Berks, in company with *C. riparia*, Er., and—
- **C. protensa, Mann.** Not uncommon in damp grass-tufts in both localities, 30th March and 3rd April, 1909.
- **C. rufescens, Kr.** One or two specimens, taken with the two preceding, are apparently to be referred to this species.
- Chilopora longitarsis, Er.** In sand-pit near Cumnor, 9th April, 1908; also sparingly in flood-refuse at King's Weir, &c.
- *Dinarda markeli, Kies.** In nests of *Formica rufa* at Tubney, sparingly; 15th March, 1908 (*J. C.*).
- Myrmedonia funesta, Grav.** { These three species were taken by Mr. J. Collins in company with *Lasius fuliginosus* near Cothill, 21st June, 1908, and afterwards, not rarely, especially the last.
- *M. lugens, Grav.** {
- M. laticollis, Grav.** {
- **Notothecta confusa, Märk.** Taken rarely by Mr. A. H. Hamm in company with *Lasius fuliginosus* on Shotover Hill, 20th June, 1908.
- Homalota gyllenhali, Thoms.** King's Weir and Yarnton, in wet places, scarce (*J. C.*).
- **H. nitidula, Kr.** Yarnton, 24th March, 1906, one specimen (*J. C.*).
- *H. oblongiuscula, Sharp.** Tubney, 9th August, 1907; also at Water Eaton (*J. C.*).
- *H. pagana, Er.** By sweeping under trees at Wytham Park, rare, 17th September, 1908.
- **H. fallaciosa, Sharp.** In damp moss at Yarnton, rare, 4th August, 1908 (*J. C.*).
- *H. gemina, Er.** Taken sparingly in moss at Yarnton by Mr. Collins and myself.
- *H. exilis, Er.** In damp tufts at Bayworth, scarce, 3rd April, 1909; also near Islip.
- *H. boletobia, Thoms.** Tubney, in fungi, 1st September, 1907 (*J. C.*).
- H. gagatina, Baudi.** Wytham Park and Tubney, rare (*J. C.*).

- H. palustris*, Kies. Cothill, in moss, three examples, 7th June, 1908 (*J. C.*).
- **H. puberula*, Sharp. Wytham Park, by sweeping in autumn, sparingly, 1908 and 1909; also at Tubney.
- **H. oblita*, Er. Water Eaton, 12th March, 1907; Tubney, &c. (*J. C.*).
- H. atricolor*, Sharp. Wood Eaton, 12th April, 1908; also at Tubney (*J. C.*).
- **H. marcida*, Er. In fungus at Tubney, 26th October, 1907 (*J. C.*).
- **Falagria thoracica*, Curt. Among dead leaves at Cothill, rare, 26th July, 1908 (*J. C.*).
- Gyrophæna affinis*, Mann. In fungus at Tubney, not rare, 11th July, 1907 (*J. C.*).
- **Placusa pumilio*, Gr. Under sappy oak-bark at Besselsleigh, 29th May, 1909.
- **Sipalia ruficollis*, Er. Hen Wood, under bark, 1st November, 1908 (*J. C.*): also in faggots at Wytham Park by myself.
- Oligota inflata*, Mann. In vegetable refuse; Wood Eaton and Wytham (*J. C.*).
- O. punctulata*, Heer. Water Eaton, one example, 12th October, 1908 (*J. C.*).
- **Myllæna kraatzii*, Sharp. Yarnton, in wet tufts and moss; rare, 20th April, 1908.
- **M. infuscata*, Matt. In wet moss; Yarnton, Cothill, &c., not scarce (*J. C.*).
- **M. brevicornis*, Matt. Taken by the late A. J. Chitty at Bagley Wood in my company, 20th May, 1907, and in moss at Cothill, not rarely, by Mr. J. Collins, 4th July, 1909.
- **Hypocyptus punctum*, Mots. In vegetable refuse, Wytham Park, rare (*J. C.*).
- **Tachyporus transversalis*, Grav. In wet places, King's Weir, 4th April, 1908; also at Yarnton, sparingly.
- ***Mycetoporus longicornis*, Kr. In tufts of grass at Prattle Wood, near Wood Eaton; rare, 12th April, 1908 (*J. C. and J. J. W.*).
- ***Euryporus picipes*, Payk. One example of this fine and rare Staphylinid taken by Mr. W. Holland on the Canal bank near Yarnton, 3rd June, 1908.
- ***Quedius scitus*, Gr. One example running on a wall in Parks Road, Oxford, 30th September, 1908.
- Q. suturalis*, Kies. Taken sparingly in various localities by Mr. Collins and myself.
- **Philonthus vernalis*, Gr. In moss at Cothill, one specimen, 25th April, 1909 (*J. C.*).
- **P. thermarum*, Aubé. In manure-heaps near Summertown; not rare, 22nd September, 1909.
- **Actobius signaticornis*, Muls. On a wall near Oxford Railway Station; one specimen, 19th May, 1909.
- ***Lathrobium pallidum*, Nordm. This rare species was found in some small numbers in flood-refuse on Sparsey Bridge, 1st to 9th May, 1908, by Mr. H. G. Champion, Mr. J. Collins and myself.
- **Scopæus sulcicollis*, Steph. In sand-pit near Cumnor, 1st August, 1908, one example (*J. C.*).
- **Medon brunneus*, Er. In a mole's nest near Wytham; one, 29th March, 1908 (*J. C.*).
- **M. obsoletus*, Nord. Wood Eaton, flying over manure-heap; one specimen, 6th August, 1909.
- **Sunius intermedius*, Er. By sweeping near Oddington; one, 27th May, 1908.

Dianöus cœrulescens, Gyll. One specimen in flood-refuse on Sparsey Bridge, 2nd May, 1908.

**Platystethus capito*, Heer. Wytham, on the wing, April, 1908; also at Yarnton (*J. C.*).

Homalium punctipenne, Thoms. Wytham Park, under bark, 4th September, 1908, not rare; also at Cothill (*J. C.*).

***H. salicis*, Gyll. One specimen of this very rare species taken by evening sweeping at Wood Eaton, 31st May, 1909.

**H. planum*, Payk. Under sappy oak-bark at Besselsleigh, rare, 29th May, 1909.

FAMILY Silphidæ.

Agathidium marginatum, Sturm. At roots of herbage in summer; Tubney, found not rarely by Mr. J. R. le B. Tomlin and myself.

***Anisotoma anglica*, Rye. This fine species has been taken at Wytham Park, 12th September, 1908 (*J. C.*), and by myself on 16th October of the same year and on 1st October, 1909.

***A. brunnea*, Sturm. Both sexes of this very rare species taken by sweeping under fir trees at Tubney, 15th September, 1909; also taken there by Mr. Tomlin, 9th October.

***Triarthron markeli*, Schm. One specimen, by sweeping under firs at Tubney, 20th September, 1909.

**Choleva fusca*, Panz. Widely but sparingly distributed throughout the district; I find it in vegetable refuse in my garden at Summertown.

***Colonia latum*, Kr. One specimen in moss at Cothill, 25th April, 1909 (*J. C.*).

FAMILY Scydmaenidæ.

***Neuraphes rubicundus*, Schaum. One example of this rare species found in a mole's nest near Yarnton, 21st February, 1909 (*J. C.*).

[***Euthia schaumii*, Kies. The insect recorded in the "Preliminary List" as *E. plicata*, Gyll., must be referred to this species, which has since been taken by Mr. Collins in decayed wood at Wood Eaton, and by myself in numbers by evening sweeping near Wolvercote Paper Mill, 9th September, 1909.]

FAMILY Pselaphidæ.

**Bythinus burrelli*, Denny. In moss at Bagley Wood, rare, February, 1905 (*W. H.*).

***Batrachus venustus*, Reich. In a nest of *Lasius fuliginosus* near Cothill, April, 1909, one example (*J. C.*).

FAMILY Coccinellidæ.

**Scymnus pygmaeus*, Fourc. One example, in sand-pit near Cumnor, 20th June, 1909 (*J. C.*).

FAMILY Endomychidæ.

**Lycoperdina bovistæ*, F. This curious beetle has occurred rather freely at Tubney in small ripe puff-balls in late autumn; first taken, 1st October, 1908.

FAMILY Colydiidæ.

***Myrmecoxenus vaporariorum*, Guér. In a manure-heap near Summertown; one example, 22nd September, 1909.

FAMILY **Nitidulidæ.**

- Epuræa pusilla*, Ill. At oak sap, Wytham Great Wood, 17th August, 1909 (*J. C.*).
 **Meligethes ochropus*, Sturm. By sweeping at Yarnton; two examples, 6th August, 1908 (*J. C.*).
 **M. bidens*, Bris. By sweeping at Tubney, 26th July, 1908 (*J. C.*); also found not rarely at Hen Wood on *Teucrium Scorodonia*.
 **Pityophagus ferrugineus*, F. In sappy oak stump at Besselsleigh; one example, 29th May, 1909.
Rhizophagus parallelocolis, Gyll. One example in Lonsdale Road, Summertown, 24th May, 1909.
 ***R. politus*, Hell. One example by sweeping on Canal bank near Blethington Station, 22nd May, 1909 (*A. H. Hamm*).

FAMILY **Monotomidæ.**

- **Monotoma quadricollis*, Aubé. { Both taken not rarely in haystack
 **M. rufa*, Redt. { refuse near Yarnton, 5th June,
 1909 (*J. C.*).
 **M. longicollis*, Gyll. In manure-heap near Wood Eaton; one example, 6th August, 1909.

FAMILY **Lathridiidæ.**

- **Cartodere elongata*, Curt. Besselsleigh and Tubney, in decayed wood; rare, 29th May, 1909.
 **Melanophthalma similata*, Gyll. By beating spruce-firs at Tubney; taken not rarely by Mr. Tomlin and myself, June, 1909.

FAMILY **Cucujidæ.**

- **Silvanus mercator*, Fauv. On warehouse walls near Railway Station, rare.

FAMILY **Cryptophagidæ.**

- ***Cryptophagus subdepressus*, Gyll. By beating spruce-firs at Wytham Great Wood, sparingly, 3rd June, 1909 (*J. C.*), and subsequently taken there by me.
C. bicolor, Sturm. Tubney, by sweeping, 8th August, 1909 (*Prof. T. Hudson Beare*).
 **Paramecosoma melanocephalum*, Herbst. In flood-refuse at Enslow Bridge, rare, 21st May, 1908.
 **Atomaria peltata*, Kr. By sweeping near Cothill, rare, 15th July, 1909.
A. pusilla, Payk. In vegetable refuse, Water Eaton, July, 1908 (*J. C.*).
 **A. berolinensis*, Kr. In dead leaves, &c., Wytham, 3rd July, 1909 (*J. C.*); also taken by myself at Cothill.
A. apicalis, Er. In vegetable refuse; Wood Eaton, 7th July, 1907; also at Water Eaton and Cothill (*J. C.*).

FAMILY **Parnidæ.**

- **Elmis subviolaceus*, Müll. { These two species were taken freely by Mr.
 **E. cupreus*, Müll. { Collins adhering to small stones in a
 stream near Islip, 8th April, 1909, and
 are also found not rarely in Bayswater
 Brook.
 **Parnus luridus*, Er. I have taken this recently introduced British species in a little swamp near Kidlington, 12th May, 1909.

FAMILY Scarabæidæ.

- **Aphodius tristis*, Panz. Cothill and Tubney, singly, in dung, April and June, 1909 (*J. C.*)

FAMILY Eucnemidæ.

- **Throscus obtusus*, Curt. In grass-tuft in a wet place near Wytham Park, 2nd December, 1906 (*J. C.*), and taken there in moss by myself, 4th April, 1908. The type-specimen of this interesting little species, described and figured by Curtis (*Brit. Ent.*, plate 163, May, 1827), was "beaten by myself (Prof. Westwood) from an oak "tree near the village of Ensham (between Oxford and Witney) at the "beginning of last September (1826)," and is now in the Hope-Westwood collection of British *Coleoptera* in the Oxford University Museum.

FAMILY Dascillidæ.

- **Dascillus cervinus*, L. This rather conspicuous beetle occurs locally but not uncommonly near Cothill on flowers in early summer; first taken 10th June, 1908.
- Cyphon padi*, L. In moss, &c., at Varnton, February and March, 1908 (*J. C.*).
- ***Prionocyphon serricornis*, Müll. A single example of this rare species was beaten from spruce-fir at Tubney by Mr. P. Harwood, 25th June, 1909.

FAMILY Telephoridæ.

- **Malthodes dispar*, Germ. By sweeping at Cothill, occasional, 15th July, 1909.
- **M. fibulatus*, Kies. A ♂ example taken by sweeping at Wytham Park, 23rd May, 1909 (*J. C.*).
- **Psilothrix nobilis*, Ill. By sweeping near Cothill; one example, 22nd May, 1909.

FAMILY Cleridæ.

- **Tillus elongatus*, M. A single example on *Glyceria aquatica*, by the river-side between Binsey and Godstow, 12th July, 1909. Usually found on old timber.
- **Corynætes cœruleus*, De G. By sweeping near Tubney; rare, 10th June, 1908.

FAMILY Ptinidæ.

- ***Ptinus sexpunctatus*, Panz. In house, Southfield Road, 17th June, 1909 (*A. H. Hamm*).

FAMILY Cissidæ.

- Cis hispidus*, Payk. In powdery fungus on old willow near Wytham, 29th October, 1905 (*J. C.*).
- **C. pygmæus*, Marsh. One example at Shotover, 5th August, 1907 (*J. C.*).
- **C. fuscatus*, Mell. By sweeping at Water Eaton, one example, 5th September, 1909 (*J. C.*). I have found this species in numbers, in fungus on decaying birch at Weston-on-the-Green.
- **Rhopalodontus fronticornis*, Payk. In fungus with *Cis hispidus* near Wytham, 29th October, 1905 (*J. C.*).
- **Ennearthron cornutum*, Gyll. In fungus on birch stump, Wytham Park, 22nd October, 1907, and by sweeping at Tubney (*J. C.*).

FAMILY **Bruchidæ.**

Bruchus pisi, L. Specimens of this beetle found by Prof. Poulton in dried peas purchased in Market Street, Oxford, in 1904, are in the University Museum.

FAMILY **Chrysomelidæ.**

***Cryptocephalus bilineatus, L.** Not rare on *Anthyllis vulneraria* on the railway-bank near Yarnton; first found by Mr. Collins, 3rd July, 1908.

C. pusillus, F. On low bushes in summer, Wood Eaton, 30th July, 1907, also at Yarnton and Hen Wood (*J. C.*); I have found it at Cothill.

Gastroidea viridula, De G. Sparsey Bridge in flood-refuse, 1st May, 1908; also by sweeping on the Cherwell banks.

Galerucella sagittariæ, Gyll. On marsh herbage at Yarnton, not rare, 6th July, 1908 (*J. C.*).

***Longitarsus nasturtii, F.** By sweeping at Tubney, rare (*J. C.*).

FAMILY **Cistelidæ.**

***Cistela luperus, Hbst.** By sweeping at Cothill; one specimen, 30th May, 1908.

FAMILY **Melandryidæ.**

****Tetratoma desmaresti, Latr.** By sweeping under beech trees at Wytham Park; one example, 17th October, 1908 (*J. C.*).

***Hallomenus humeralis, Panz.** One example, taken by Mr. A. H. Hamm in his garden in Southfield Road, 20th June, 1909.

****Anisoxya fuscata, Ill.** Single examples, taken by me at Tubney, 15th September, 1909, and by Mr. G. C. Champion at Wytham Park, 2nd October, 1909; in both instances by sweeping under beech trees.

****Abdera quadrifasciata, Curt.** Taken singly by sweeping at Wytham Park, by Mr. H. St. J. Donisthorpe, 5th July, 1908, and found in some numbers by us on the same day, running on the bare wood of a dead beech tree; again met with on the same tree, July and August, 1909.

****A. bifasciata, Marsh.** One example, beaten out of spruce-fir at Tubney by Mr. P. Harwood, 25th June, 1909.

FAMILY **Pythidæ.**

***Rhinosimus ruficollis, L.** By sweeping at Wytham Park, 16th October, 1908; subsequently found there not rarely under beech bark by Mr. J. Collins.

FAMILY **Meloidæ.**

[**Sitaris muralis, Forst. var. flava, Hamm.** (*Ent. Mo. Mag.*, 1909, p. 277). This well-marked variety has been taken sparingly since 1907 by Mr. A. H. Hamm, on walls near Iffley in autumn.]

FAMILY **Anthribidæ.**

***Choragus sheppardi, Kirby.** By sweeping at Tubney Wood; one example, 26th August, 1908 (*J. C.*).

FAMILY **Curculionidæ.**

***Apion hookeri, Kirby.** By sweeping near Tubney; rare, 23rd July, 1909.

Phyllobius pomonæ, Ol. Generally distributed, and common in early summer by sweeping, &c.; the var. *cinereipennis*, Gyll. is fairly frequent at Tubney.

- **Tanymecus palliatus*, F. Sparsey Bridge, in flood-refuse, 1st May, 1908; taken in large numbers by sweeping *Centaurea Scabiosa* on Pixey Mead, near King's Weir, in July, 1909.
- ***Liosoma oblongulum*, Boh. One example of this rare species found while gathering primroses at Wytham Park, 28th April, 1909.
- **Dorytomus hirtipennis*, Bedel. On sallow at King's Weir; one specimen, 12th July, 1909.
- Bagous alismatis*, Marsh. In a swamp near Kidlington, not rare, 27th April, 1909; also on *Alisma Plantago* at King's Weir in July.
- **B. claudicans*, Boh. (frit. Sharp Cat.). In wet moss at Yarnton, 10th August, 1908 (*J. C.*); found there subsequently by myself, sparingly.
- **Tychius squamulatus*, Gyll. In flood-refuse at Sparsey Bridge, 1st May, 1909; also by sweeping at Wood Eaton.
- **T. lineatulus*, Steph. By sweeping near Cothill; one specimen, 30th May, 1908 (*J. C.*).
- **T. meliloti*, Steph. On *Melilotus officinalis* on the railway-bank near Yarnton, not rare, 11th July, 1908 (*J. C.*). I have taken it on the same plant both there and at Radley.
- T. tomentosus*, Herbst. Yarnton, by sweeping, scarce, 11th July, 1908 (*J. C.*).
- ***Gymnetron rostellum*, Herbst. By sweeping at Tubney, one example, 14th October, 1908; found there sparingly in the late summer of 1909 by Prof. T. Hudson Beare, Mr. J. Collins and myself. Apparently attached to *Veronica officinalis*.
- **Cœliodes geranii*, Payk. On *Geranium pratense*; taken by Mr. W. Holland near Enslow Bridge, July, 1908.
- **Ceuthorrhynchus moguntiacus*, Schultze. By sweeping at Wytham Park; rare, 3rd October, 1909.
- ***Rhytidosomes globulus*, Herbst. I found a single example of this rare and curious little weevil on *Populus canescens* at Cothill, 10th June, 1908, and in July and September, 1909, obtained a good series on small saplings of this tree at the same spot.

FAMILY Scolytidæ.

- **Scolytus intricatus*, Ratz. Found rather commonly in oak bark at Bagley Wood by Mr. G. H. Grosvenor, M.A., in 1909. I have also taken it by sweeping at Prattle Wood.
- ***Hylastes cunicularius*, Er. Also found not rarely by Mr. Grosvenor at Bagley Wood in 1909, attacking spruce-fir.
- Pityogenes bidentatus*, Herbst. By sweeping under fir trees; Wytham Park, 29th September, 1908; also at Tubney.
- **Xyleborus dryographus*, Ratz. By sweeping at Tubney, 15th July, 1909.

The species included in this "Second Supplement" to the "Preliminary List" fall into the primary divisions of the Order COLEOPTERA as follows:—

GEODEPHAGA	...	3 species	MALACODERMATA	...	14 species
HYDRADEPHAGA	...	4 "	PHYTOPHAGA	...	6 "
PHILHYDRIDA	...	6 "	HETEROMERA	...	7 "
BRACHELYTRA	...	64 "	RHYNCHOPHORA	..	19 "
NECROPHAGA	...	33 "			
LAMELLICORNIA	...	1 "			
STERNOXI	...	1 "			
			TOTAL		158 species.

This brings the number of species of *Coleoptera* recorded from our District, from 1819 to the present date, up to a grand total of 1,738. The "Catalogue of British Coleoptera" by Prof. T. Hudson Beare and Mr. H. St. J. Donisthorpe, published in March, 1904, enumerates as truly British 3,274 species, to which number about 75 have been added since its publication, making a total of about 3,350 species. It will thus be seen that in our "Preliminary List" and the two "Supplements," considerably more than half the total number of our indigenous beetles are recorded as having been found within the area comprised in a radius of seven miles from Carfax. By a somewhat curious coincidence, this number represents almost exactly 1 per cent. of the described species of *Coleoptera* of the whole world (172,500), according to the recent estimate of Dr. A. Handlirsch (quoted by Nathan Banks, Smithsonian Institution, Bulletin 67, U.S. National Museum, p. 4, 1909).

JAMES J. WALKER.

31st December, 1909.

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

(FEBRUARY 5TH—JUNE 3RD, 1908).

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Wednesday, February 5th, 1908.

LARVÆ OF SITARIS MURALIS.—Commander J. J. WALKER showed on behalf of Mr. A. H. HAMM, very young larvæ of *Sitaris muralis*, hatched at end of October and beginning of November from ova laid by ♀ ♀s in captivity (the natural place of deposit of these eggs being at the entrance to the burrow of the bee, *Anthophora pilipes*, in stone walls near Oxford). Hitherto the larvæ had kept together on the mass of empty egg-shells.

PYRALIS LIENIGIALIS AT OXFORD.—Commander WALKER also exhibited two specimens of the rare *Pyralis lienigialis*, Zell, ♀, taken at light in his house at Summertown, August 1906 and 1907.

SUGGESTED MIMICRY IN BOURBON BUTTERFLIES.—Lieut.-Colonel MANDERS exhibited the ♀ of *Papilio phorbanta* from Bourbon, an aberrant member of the *nireus* group of Papilios, and compared it with the other members of the same group from the African mainland, Madagascar and Mauritius, kindly lent for the purpose by Professor Poulton. He pointed out

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that whereas in all the other species the ♀ ♀s were some shade of green similar to the ♂ ♂s, the Bourbon insect was more or less uniformly brown. He suggested that this was due to mimicry, *Euploea goudoti*, a species strictly confined to Bourbon, being the model. The case had been dealt with more fully and the insects figured in his paper on "The butterflies of Mauritius and Bourbon," in the Transactions 1907.

MIMICRY IN THE BUTTERFLIES OF MAURITIUS AND BOURBON.—Professor E. B. POULTON, F.R.S., exhibited a series of species of the *Papilio nireus* group from many parts of Africa, from Madagascar, Mauritius and Bourbon, together with other Rhopalocera from the two latter islands bearing on the subject of mimicry. He said that his attention had been directed to the difficult and fascinating problems presented by these small outlying islands by the recent interesting observations and experiments of Colonel N. Manders, to whose kindness he owed the opportunity of exhibiting some of the specimens.

The black blue-marked upper-surface of the wings in the numerous species and sub-species of the *Papilio nireus* group presented a singularly uniform and characteristic appearance throughout Africa and Madagascar. It appeared probable to the speaker that these forms constituted a definite Ethiopian synaposematic group. One of the species (*epiphorbas*, Boisd.) in Madagascar had, however, spread into Mauritius as *Papilio manlius*, F., and into Bourbon as *P. phorbanta*, L. (*disparilis*, Boisd.). These two island-forms were entirely separated geographically from other members of their abundant and dominant group, while they at the same time came into contact with *Eupleas* of a characteristic Oriental type of colouring, with *E. euphone*, F., in Mauritius, with *E. goudoti*, Boisd., in Bourbon. Under these circumstances the dark ground-colour of the female *Papilio* in Mauritius has faded to a brown shade not unlike that of the *Eupleas*, while the blue markings have lost their sharp outlines and have become slightly reduced in size as compared with those of the male. The mimicry is, of course, in a very incipient stage—so incipient, indeed, as to be probably unrecognisable were it not for the far more complete resemblance attained by the female of *phorbanta* in Bourbon. With this latter female

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before us it is impossible to doubt the significance of the differences which separate the female of *manlius* from its male. In the female of *phorbanta* the central blue patches have entirely disappeared, while the blue submarginal spots of the hind-wing have become increased in size and transformed into white. Furthermore, the ancestral submarginal

band of blue spots in the fore-wing has also been transformed into white. These changes, with the exception of that last mentioned, produce a rough mimetic likeness to *Euplœa goudoti*, as may be seen in Colonel Manders' beautiful plate (Trans. Ent. Soc. Lond., 1907, Pl. xxix, figs. 6a and 1). It is evident from Colonel Manders' account (l. c., p. 451) that the resemblance which appears to be so slight in the cabinet is much enhanced by the mode of flight, and the fact that *Papilio* and *Euplœa* inhabit the same localities. Nevertheless it is impossible to be satisfied with the simple conclusion that the female *phorbanta* has gained its present pattern under the sole influence of *Euplœa goudoti* as we now know it in Bourbon.

The ancestral submarginal blue spots of the hind-wing of the male *phorbanta* are already somewhat larger than the white spots occupying a similar position in *Euplœa goudoti*. The blue spots transformed to white cannot therefore have undergone a further increase in size in the female under the influence of the existing *Euplœa*. Nor is it possible to account by the same influence for the submarginal white spots of the fore-wing of *phorbanta*; for Colonel Manders (l. c., p. 435) only knows of a single specimen of *goudoti* "with faint but decided indications of a submarginal row" in the fore-wing. It is obvious that the present pattern of the Bourbon *Euplœa* cannot afford us the interpretation of the change which has occurred in the female *Papilio*.

If the upper-surface pattern of the female *phorbanta*, fig. 6a, on Colonel Manders' plate, be compared with that of *Salamis augustina*, fig. 3, and *Euplœa goudoti*, fig. 1, it will at once be seen that the *Papilio* bears a far closer resemblance to the Nymphaline than to the Euplœine. Now the upper-surface of the *Salamis* is a fair mimic of the Mauritian *Euplœa euphone*, as was pointed out by Mr. Roland Trimen, F.R.S., in 1866:—"In spite of the very different outline of wings, the general vi] coloration of this butterfly bears considerable resemblance to that of *Euplœa euphone*, and I can well imagine its escaping notice if flying in company with the latter species" (Trans. Ent. Soc. Lond., 1866, p. 335).

We are therefore led to the conclusion that *phorbanta* has

also been influenced by *euphone*. The situation is thus extremely puzzling, the female *Papilio* being a far better mimic of the Mauritian *Euplœa* than of the species with which it flies in the island of Bourbon. There can be little doubt that the Mauritian *euphone* presents a more ancestral pattern than *goudoti*. The *Euplœa* mimics of both islands are always mimetic of *euphone*: they never attain the features by which *goudoti* is distinguished from *euphone*. This is not only true of the *Papilio* and *Salamis*, but also of the Mauritian *Amauris* (*Berethis*) *phædone*, F. Concerning this latter species Mr. Roland Trimen, F.R.S., observed in 1866 that "its peculiar facies and colouring give it a strong superficial resemblance to *Euplœa euphone*" (Trans. Ent. Soc. Lond., 1866, p. 332). He furthermore states that he "found *D. phædone* much scarcer than *E. euphone*, but almost invariably flying in company with the latter." * Inasmuch as these mimetic resemblances to *euphone* cannot have been attained except in the course of a long period of time, the pattern of this *Euplœa* must be ancient as compared with that of *E. goudoti*, which has produced no apparent effect on its own account.

Furthermore, it must be pointed out that the upper-surface pattern of the unique and remarkable *Libythea cinyras*, Trim., is probably roughly mimetic of *Neptis frobenia*.

We have been accustomed to look upon islands as the homes of the non-mimetic ancestors of mimetic species; but Mauritius and Bourbon prove that an exceptional development of mimicry may be found among the members of small communities confined in very restricted areas. It has been already stated that the mimicry of the female *phorbanta* is unique in the *nireus* group. If I am right in supposing

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Libythea cinyras to be a mimic, it too is a unique example in its group. *Salamis augustina* is also a nearly equally rare instance in the genus.

A fascinating aspect of the mimicry in these islands is to be

* So far as I have had the opportunity of examining it *phædone* seems to be related to *Amauris albimaculata*, Butl., rather than to *A. echeria*, Stoll. Dr. Karl Jordan whom I have consulted on the point kindly informs me that he agrees with the above conclusion as to the affinity of *phædone*.

found in the extraordinary effect of one of the most dominant and distasteful types of the Oriental Region upon characteristic Ethiopian forms. Ethiopian species of *Amauris*, *Salamis* and *Papilio* all exhibit the influence of *Euploea*. It is most unfortunate that the question was not studied many years ago when the aspect of the country and the indigenous fauna were comparatively unchanged. As Colonel Manders suggests, we might then, in all probability, have attained to a precise knowledge of the selective forces by which the approach has been brought about.

In conclusion, Professor POULTON desired again to thank Colonel Manders for directing the attention of the Society to the deeply interesting problems presented by the faunas of these two islands; and personally he wished to thank him for much kind help both in information and material. He had also been greatly indebted to Mr. Roland Trimen, F.R.S., with whom he had discussed the whole question, and from whom he had received many valuable suggestions.

SECONDARY MIMETIC RESEMBLANCE OF ITHOMIINÆ TO THE DANAINÆ GENUS ITUNA.—Professor E. B. POULTON said that he was indebted to the kindness of Mr. W. J. Kaye, F.E.S., for the opportunity of exhibiting what seemed to him a very interesting example of secondary mimicry. In 1898 he had described and figured in the Zoological Journal of the Linnean Society (Vol. xxvi, p. 558) the great combination of South American Lepidoptera which is ranged round the two chief models *Methona confusa*, Butl., and *Thyridia psidii*, L. The combination included numbers of *Ithomiinæ* belonging to several genera, two species of *Ituna* (*Danainæ*), one of *Pierinæ*, and many Heterocera belonging to the *Castniidæ* and *Pericopidæ* (*Hypsidæ*). At the time when that paper was written he had no conception of the predominance of secondary resemblances between mimics, and had naturally failed to find what he never looked for. However, a few weeks ago he saw in Mr. Kaye's collection the specimens now being exhibited, and at viii]

once realised that the Ithomiine *Eutresis imitatrix*, Staud., is an exceedingly good secondary mimic of *Ituna* itself, the historic mimic of *Thyridia* (and *Methona*) upon which Fritz Müller

based his theory. Reference to the Linnean Society plate published in 1898 showed that nearly all the points of secondary resemblance are clearly displayed, although they had never been recognised. It was almost humiliating to realise the dependence of observation on hypothesis.

After recognising this interesting example of secondary mimicry in Mr. Kaye's collection, the fine series in the British Museum, including, in these groups, the Godman-Salvin material, was carefully studied with Mr. G. A. K. Marshall's kind assistance. In the course of the examination certain features of the primary Ithomiine models, *Methona confusa* and *Thyridia psidii*, were compared and the conclusion reached that, as regards these points, the *Methona* has acted as model and the *Thyridia* as mimic. The whole of the conclusions arrived at are embodied in the following account.

The general appearance of *Eutresis imitatrix* is far more that of *Ituna phenarete*, D. & H., than of *I. ilione*, Cram. The latter is a smaller, more intensely and heavily black-marked, yellower and less transparent insect than *phenarete* and its Ithomiine mimic.

The black-shafted, yellow- or orange-clubbed antennæ form one of the most conspicuous features of the *Methona-Thyridia*-centred combination, and one in which mimetic resemblance is very obvious. It is therefore of great interest to compare the colouring of the antennæ in species of *Ituna* and *Eutresis* with each other and with the *Methona* and *Thyridia*.

Ituna lamirus, Latr. The antennæ are yellow, darkened at the extreme base. This darkening extends throughout the basal half in a male specimen from the interior of Colombia, and still farther in a male from the Rio Napo. These are the only exceptions in the series of 41 specimens of *I. lamirus* in the British Museum.

Ituna ilione. The antennæ resemble those of the primary Ithomiine models: *Methona confusa* and *Thyridia psidii*, being intensely black with an orange club.

Ituna phenarete. The club of the antenna is much longer [ix
and of a paler colour than in *ilione*. It also tapers more gradually into the shaft on to which the yellow tint is often

prolonged, generally for a short distance, occasionally as far as in *I. lamirus*.

Eutresis imitatrix and an allied unnamed species. The antennæ resemble the appearance most usual in *I. phenarete*, but the depth of the orange tint is as in *I. ilione*. A similar appearance is presented by the females and 2 males of *Eutresis hyspa*, Godm. and Salv.

Eutresis other species. The antennæ of 4 males of *E. hyspa* and of all the remaining species of the genus are similar to those of *I. lamirus*.

Hence as regards this prominent feature, the brownish translucent *Ituna lamirus* resembles the similarly coloured species of *Eutresis*; the transparent black-marked species of *Eutresis* (*imitatrix*, etc.) resemble the transparent and black *I. phenarete*; while *Ituna ilione* resembles the primary Ithomiine models.

The remaining points of comparison are confined to elements in the pattern of the upper surface of the fore-wing.

All the species of *Eutresis* in the British Museum, except *E. imitatrix*, a single specimen of an allied unnamed form, and certain individuals of *E. hyspa*, possess, on the fore-wing upper-surface a submarginal row of six internervular pale yellowish spots, somewhat more yellow and less transparent than the large transparent areas of the wing. In *E. imitatrix* and the undescribed form, the four submarginal spots nearest the apex, although still traceable by change of tint and degree of transparency, fuse with and become part of the large apical transparent area. The same tendency, although less marked, is seen in *Eutresis hyspa*, especially in two females from Ecuador. In the above-mentioned three forms the black band which in other species cuts off the four apical spots from the transparent area, becomes very indistinct, and resembles a faint cloudy dark bar which in the transparent *Itunas* also cuts off a more opaque yellower distal section of the apical area. Comparing these *Itunas* (*ilione* and *phenarete*) with the less transparent *I. lamirus*, Latr., it is seen that the faint cloudy bar corresponds to the black ground-colour which x]

separates a row of three subapical spots from a more centrally

placed row of four spots, of which the lowest and outermost approaches the margin, reaching the position of the fourth submarginal spot of *Eutresis*. In some individuals this outermost spot also exhibits faint traces of increased yellowness and opacity at its outer and lower extremity.

The fifth and sixth submarginal spots of the fore-wing of *Eutresis imitatrix*, the allied form, and *E. hypsa*, as regards their black internal contours, resemble *Ituna ilione* more closely, as regards their transparency.—*I. phenarete*.

The black transverse bar which descends from the costa of the fore-wing and crosses the cell, forms nearly a right angle with the costa in *Methona confusa*, while in the transparent Ecuador form *psamathe*, Godm. and Salv., it is sometimes rather less than a right angle on the basal side, rather more on the distal. In *Thyridia psidii* the bar is always obliquely directed, forming an acute angle with the costa on the distal side. In *Ituna phenarete* and *Eutresis imitatrix* it is still more oblique and the distal angle even more acute. Of more importance is the direction of the bar, which is almost straight in the *Methona* and the *Thyridia*, but turns inwards at or sometimes below the point at which the first median nervule leaves the median nervure, in *I. phenarete* and *E. imitatrix*. The elbow is rendered prominent by an extension of the black marking on the convexity of the bend. As regards this feature *I. ilione* has apparently been drawn towards the primary Ithomiine models; for the elbow is far less marked than in *phenarete*.

Furthermore, in both species of *Ituna* and in *Eutresis imitatrix*, a small triangular portion is cut off by the median nervure from the outer and lower part of the basal transparent area. In *Methona confusa*, on the other hand, the broad black inner margin reaches the median nervure, and obliterates this part of the basal area. In *Thyridia psidii* a more or less distinct trace of transparency nearly always persists in this region below the nervure, although the condition of *Ituna* and *Eutresis* is apparently never equalled.

As regards the two primary models it is evident that in this last-mentioned feature the *Methona* has been mimicked

by the *Thyridia*; for the species allied to the former,—*Methona themisto*, Hübn., and *M. singularis*, Staud.,—resemble *M. confusa*; while in the *Thyridias* allied to *psidii*,—*pallida*, Godm. and Salv., *ceto*, Feld., and *ædesia*, D. & H.,—a comparatively large section of the pale basal area is visible below the nervure. *Thyridia hippodamia*, F., presents a condition similar to that of *T. psidii*.

There is also a tendency in the *Itunas* and especially in *Eutresis imitatrix*, for the median transparent area to be nearly equally divided by the black and prominent vein which traverses it. This tendency is less marked in the *Thyridia*, and still less in the *Methona*; and here too the latter has apparently acted as the model for the former; inasmuch as in the allied *Thyridia ædesia*, the area in question is divided by a heavily marked band.

Finally, the facts of geographical distribution entirely support the conclusion that the transparent species of *Eutresis* are mimics of *Ituna phenarete* and not of *I. ilione*. The latter is an eastern and southern species: of 16 examples in the British Museum, 2 are from Rio, 2 from Minas Geraes, 3 from Brazil, 2 from S. Brazil, and 7 from Paraguay. *I. phenarete*, on the other hand, is a western species: of 15 examples, 10 are from Bolivia, 3 from Peru, 1 from Ecuador and 1 from Tabatinga (Amazons). The three examples of *Eutresis imitatrix* and all of *E. hypsa* are from Ecuador, while the single undescribed form is from Peru.

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MIMETIC RELATION OF NYCHITONA AND PSEUDOPONTIA.—Dr. F. A. DIXEY exhibited specimens of *Nychitona medusa*, Cram., and *Pseudopontia paradoxa*, Feld., observing that a former suggestion of his as to a mimetic relation between them (see Proc. Ent. Soc. Lond., 1906, pp. lxix-lxxi) had been confirmed by a letter lately received from Mr. S. A. Neave, at present in the Congo State, who wrote that the two forms “inhabit exactly the same localities and are barely distinguishable from each other on the wing.”

Papers.

Mr. GUY A. K. MARSHALL read a paper entitled “On

Diaposematism, with reference to some Limitations of the [xiv

Müllerian Hypothesis of Mimicry." In this he pointed out the difficulty of accepting the idea of a mutual simultaneous mimicry between two unpalatable species, such as is postulated by the hypothesis of Diaposematism. It was suggested that an initial inequality in the individual numbers of the two distasteful species was an essential condition for the production of Müllerian mimicry, and that in such circumstances the mimetic approach would always be in one direction only, namely, from the rarer species towards the more abundant; for any initial variation from the latter towards the former must be disadvantageous. The various cases which have been put forward as proving the existence of Diaposematism in nature were critically examined, and it was contended that the facts could be more satisfactorily interpreted on lines which did not involve the assumption of a mutual interchange of characters between mimic and model. While the great importance of Müller's principle was fully recognised, it was pointed out that it had certain definite limitations, and the attempt to explain all cases of mimicry among butterflies on this theory was contested. On the other hand, it was held that the wide significance of Bates' principle had not been adequately appreciated, and it was urged that this theory would afford an explanation of many cases of mimicry between unpalatable species, which had been previously considered as purely Müllerian in character.

Professor E. B. POULTON, F.R.S., said that at that late hour it was impossible to reply to the details of Mr. Marshall's paper, and that any real discussion of the questions raised by him must be deferred to a future occasion. He would therefore take some other opportunity of exhibiting the specimens which he had specially selected with reference to Mr. Marshall's arguments. He had, however, just received a letter from Mr. S. A. NEAVE, F.E.S., in the Congo Free State, which, by a curious coincidence, bore upon this very discussion of the relative importance of the Batesian and Müllerian hypotheses. He was anxious that Mr. Neave's observations should appear at once in the Proceedings, and

therefore exhibited specimens in illustration of them. He reminded the Society that *Pseudacræa poggei*, Dewitz, was xv]

formerly looked upon as one of the rarest of African butterflies, and that until the recent arrival of material collected by Mr. Neave not a single example of it existed in the national collection. There was almost more *a priori* reason for regarding this butterfly as a Batesian mimic of *Danaida (Limnas) chrysippus*, L., than any other. Yet this is the very species which Mr. Byatt* observed in 1905 to exist in a proportion of nearly 5 per cent. of its model in a large consignment collected indiscriminately by natives at the sources of the Congo, and the species which Mr. S. A. Neave now finds to be by far the most abundant as well as the boldest *Pseudacræa* in the forests of the Congo Free State in which he has collected. The part of his letter bearing on this question and on the species of *Crenis* and their mimics is as follows:—

“Kambove, Congo Free State,

“November 14th, 1907.

“Since I last wrote to you I have been out to and just returned from the country to the west of this place—an extremely interesting country, and I wish I had had more time there. I took a large number of remarkable Lepidoptera. Diurnal moths were most abundant in great variety, and of extraordinary coloration. I have not, I am sorry to say, met again with the big mimetic *Pseudacræa*, although the *Aletis* models have been plentiful. *Mimacræa marshalli*, Trim., and *Pseudacræa poggei* were just beginning to reappear at the end of October, and I have taken one of each. *Hypolimnas misippus*, L., has also appeared in small numbers. I still think *P. poggei* the best mimic of *Danaida (Limnas) chrysippus*, even better than *misippus*—its *flight* is so extraordinarily like that of the model. It is rather, I think, a significant fact that of all the *Pseudacræas* I have met with (5 spp.) *poggei* is by far the most abundant; while it is bold, and not afraid to expose itself on the wing. I have taken a single specimen

* Trans. Ent. Soc. Lond., 1905, p. 264.

of a small species of *Pseudacraa* of the *boisduvali* group which I do not know.

"I can now give you a little more interesting information

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about the blue spp. of *Crenis* and *Crenidomimas concordia*, Hopff. The country I was in appears to be the metropolis of the genus *Crenis*, and they swarmed everywhere. I have taken *occidentarium*, Mab. (scarce), ? *amulia*, Cr. (very abundant), *rosa*, Hew. (abundant), *pechueli*, Dewitz (very abundant), and at least 2 spp. of the *natalensis* group, one of which is remarkable for an under-surface exhibiting an approach to the coloration and pattern of that of the blue forms. I certainly begin to suspect that the blue species of the genus, if not the others, are distasteful. They are extraordinarily bold and fearless, and collect in very large numbers wherever they can find moisture. They may often be seen, almost in hundreds, round a damp garment in one's camp. Their mimic *Crenidomimas concordia* I found much scarcer, but with very much the same habits. They are very puzzling things, because it must be remembered that they are also extremely addicted to fluttering round and settling on tree trunks often some 10-20 ft. above the ground, and under these circumstances they are *very very inconspicuous*.

"The following groups taken on one day may be of interest :—

October 26th, 1907, Lufupa R.

Crenis pechueli, 5. Near *Crenis natalensis*, group A (with bluish under-surface), 5.

Crenis ? *amulia*, 5. Near *Crenis natalensis*, group B (without bluish under-surface), 3.

Crenidomimas concordia, 1.

October 27th, 1907, 8 miles north of last locality.

C. rosa, 1. *C. amulia*, 2.

C. pechueli, 1. Near *C. natalensis*, group B, 1.

Crenidomimas concordia, 1.

October 30th, 1907.

C. pechueli and *C. concordia* taken at the flowers on the same shrub in two successive sweeps of the net.

"The above groups hardly represent the true predominance in numbers of the *Crenis*, at any rate at this time of the year (the beginning of the rains). Last April and May at the xvii]

end of the rains I found both models and mimic scarce, but *concordia* the more common of the two. This, however, was in lower and flatter country, whereas the *Crenis*, especially the large blue ones, are particularly addicted to hills."

Dr. F. A. DIXEY said that to deal with Mr. Marshall's criticisms point by point would require another treatise on the same scale as the one now before them. He therefore proposed to reserve any detailed comment for a future occasion. In the meantime he wished to thank Mr. Marshall for his courtesy in allowing him to see the paper before it had been communicated to the Society. He welcomed the opposition therein offered to his own view, because no theory could claim to stand on a firm basis until it had been well scrutinised and had run the gauntlet of adverse criticism. The author of any hypothesis that had been successfully attacked had always the satisfaction of feeling that at least he had helped to arouse interest and to stimulate inquiry; and in any event the cause of truth would be the gainer. No doubt they had from Mr. Marshall as good a statement of his side of the case as any one could make, and if his objections could be satisfactorily met, as in the speaker's opinion they could be, it was not likely that any more formidable assault would have to be faced. It would naturally be expected that he should join issue with Mr. Marshall, and this he undertook to do when the time came; meanwhile he would only make the general remark that *a priori* reasoning in similar matters had before now been known to fail, even when aided by mathematical processes as unimpeachable as those of his present critic.

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Wednesday, April 1st, 1908.

TONGUE OF AN OCHROMYIA.—Professor POULTON exhibited a preparation of the tongue of the fly *Ochromyia jejuna*, made by Mr. E. Ernest Green, F.E.S., and gave an account of some fresh observations recorded by him. These new facts, bearing

upon the discussion in Trans. Ent. Soc. Lond., 1906, pp. 394-6, were contained in a letter written Nov. 6, 1907, from which the following passages were quoted :—

“*Peradeniya, Ceylon.*”

“A flight of winged Termites came into my bungalow last night, and I was fortunate in witnessing an attack by the fly—*Ochromyia jejuna*—upon one of them. Several of the Termites had shed their wings. The fly pitched beside one of them and followed it for some time, making half-hearted feints at attack before it finally seized it. I could see that the point of attachment was at about the middle of the dorsal surface of the abdomen. As the fly seemed inclined to carry off its

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victim, I covered the pair with a glass bowl. But this alarmed the fly and it released its hold and refused to renew the attack. So I bottled the specimens and have been examining them this morning. I find that the segmental rings of the Termite are partially separated and that there is a distinct wound in the soft intersegmental tissue, from which the juices of the body are exuding. I next dissected out the tongue of the fly and—after boiling in liq. potass.—mounted it in glycerine. I was interested to find that—far from being unarmed—there is quite a battery of strong chitinous teeth and slender lancet-like points on the inner face of the apical lobes. There is first a stout median conical tooth. Near the centre of each lobe are two very dense stout curved teeth, the outermost bidentate, the inner one with small denticule on one side. Slightly above this is a series of smaller bidentate teeth—two of them mesad and one laterad of the larger teeth. Above these again is a close series of some thirteen or more sharply-pointed ligulate processes.

“In view of these very effective-looking weapons, it can scarcely be maintained that the fly is incapable of inflicting a wound.

“As this question was brought prominently before the public in your recent exhaustive paper on predatory insects, you might—if you consider these notes of sufficient interest—read them at a meeting of the Entomological Society.”

Professor POULTON said that he had shown the preparation

to Colonel J. W. Yerbury and to Mr. J. E. Collin, both of whom had compared the structure to that of the tongue in such Diptera as *Caricea tigrina*, F., and *Stomoxys calcitrans*, supporting the conclusion that *Ochromyia jejuna* possessed similar habits and powers of attack.

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Wednesday, May 6th, 1908.

BLATTIDÆ IN AMBER.—Mr. R. SHELFORD exhibited some Blattidæ in amber, forming part of the collection of Dr. R. Klebs, of Königsberg; the specimens came from the well-known deposits of Lower Oligocene age in East Prussia, celebrated even in Roman times for the large quantities of amber found in them. A great monograph on this amber fauna was written in the years 1845–1856 by Berendt and Germar; in this work 5 species of Blattidæ are figured and described, but very little has been written since then on the subject. A preliminary examination of Dr. Klebs' collection shows that it contains representatives of six genera which are identical with recent genera. These are *Ectobia* (2 species), *Ischnoptera* (1 or 2 species), *Phyllodromia* (4 to 5 species),
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Temnopteryx (1 species), *Periplaneta* (1 species), *Holocompsa* (1 species). It is remarkable to find the genera *Ectobia* and *Holocompsa* existing side by side, for at the present day the former genus is confined to the Palearctic region, whilst the latter is essentially a tropical genus. Both the species of *Ectobia* represented in the collection are allied to the recent *E. lapponica*, L., and it is difficult to avoid the conclusion that the genus was one of the few that were not driven from Europe by the onset of the glacial epoch, or in other words, *E. lapponica* appears to be a lineal descendant of the amber-enclosed species *E. baltica*. *Phyllodromia* is now represented in Europe by one doubtfully-indigenous species, but is represented by scores of species in the tropical and sub-tropical regions of the world. *Ischnoptera* and *Temnopteryx* are now found in all regions of the world except the Palearctic. The collection affords still further proof, if any was required, that

the climate of Europe in Oligocene times was tropical or sub-tropical.

LIVING BLATTA.—The PRESIDENT exhibited a living example of *Blatta* found in bananas from Mexico. Mr. SHELFORD said he thought the species to be *Panchlora nivea*, Linn.

RHINOCEROS BICORNIS FOLLOWED BY EXTRAORDINARY CESTRID FLIES (*Spathicera*) MIMETIC OF A LARGE SPECIES OF SALIUS (*Pompilidæ*).—Professor E. B. POULTON, F.R.S., said that when he visited Stockholm last May in connection with the Linnæan Jubilee, Professor Yngve Sjöstedt had shown him a number of large Dipterous larvæ which he had obtained from

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the stomach of *Rhinoceros bicornis* during his Kilimanjaro-Meru Expedition in 1905-6. Professor Sjöstedt had managed to breed a single imago, and it was a wonderful *Salix*-like insect, blue-black with orange legs like its model—large, but with something of the slender build of a Fossor. Professor Sjöstedt had recently published an interesting paper on the *Cestridæ* of his expedition (Königl. Schwedisch. Acad. Wissenschaft., Uppsala 1908, 10. Diptera, 2. Cestridæ, p. 11). In this memoir he had described and figured the species as *Spathicera meruensis*. In addition to this species, known in larval pupal and perfect states, two other species had been named from larvæ found in the digestive tract of the same mammal:—*Spathicera* (*Gyrostigma*) *conjungens*, Enderl., and *S. (G.) rhinocerontis bicornis*, Brauer—neither known in any later stage. Up to the present time no observation had been recorded of any Cestrid in the perfect state associated with or following *Rhinoceros bicornis*. But now only a few days ago the speaker had received a letter from Mr. S. A. Neave, M.A., B.Sc., F.E.S., from N.E. Rhodesia, describing what was evidently a fly of the genus *Spathicera*, as persistently following *R. bicornis* in that district. He reproduced the account in Mr. Neave's own words:—

“Upper Luangwa Valley,

“Feb. 20, 1908.

“The other day I shot a fine Bull Rhinoceros. It was accompanied by three very large and extraordinary flies. They refused to leave its carcase, and were easily caught

by hand, but I hesitated some time before doing so, as they have a *marvellous* resemblance to the large blue-black, orange-legged Hymenoptera which are so common throughout this country. I wonder if they are a known species? I suppose they must be as they are quite the most striking-looking both in colour and size that I think I have ever seen amongst Diptera. I am sorry to say that I was unable to ascertain what was the nature of their association with the Rhino."

Professor POULTON said that it was extremely satisfactory that Mr. Neave had now been able for the first time to put on record the association of a fly of the genus *Spathicera* with *Rhinoceros bicornis*.

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THE BULBUL FEEDING ITS YOUNG ON SPECIALLY PROTECTED INSECTS.—Professor POULTON communicated an interesting observation sent to him from the Nilgiris by Mr. H. Leslie Andrewes:—

"Barwood Estate, Guynd P.O., Nilgiris,

"March 19, 1908.

"This afternoon I was sitting under the veranda, with my head within about five feet of a red-whiskered bulbul's nest containing two young birds about five days old. One of the parent birds arrived with the very last butterfly I should have expected it to have any dealings with, viz., *Acraea violæ*. It sat on a stalk of the tall clump of cannas in which the nest is built, eyeing me for nearly a minute. I noticed that the butterfly was well in the bird's bill, firmly held, with the wings in considerable disarray. The body must have been fairly well crushed, so that the bulbul must have been fully alive to the flavour. I put my head within about three feet of the nest to see how the young birds took it. The bird went down and pushed the butterfly well into a youngster's throat, and it was swallowed immediately, wings and all, and the young bird settled quietly down without seeming in the slightest degree upset. To judge from Marshall's S. African notes the *Acraeas* are in anything but good odour as food, even when the bird or insect to which they are given is hungry, so that I was rather surprised to find birds voluntarily feeding their

young on one. There is other food in ample quantities for them. I spent an hour and a half after tea in seeing what they brought. I sat within five feet of the nest with a pair of glasses with which to make things out more clearly. In twenty visits (both parents) I failed eleven times to see what they brought, either through the birds being too quick for me, or through not being able to make out small insects, and so on. What I did see were:—three spiders, one Noctuid larva, two crickets, a bright red beetle which *looked* like a Lycid, though I couldn't be certain of this (the only other red beetle in these parts of that shade is a velvety Clerid, as far as I know), and a large black and white Hyspid moth, I think *Hypsa complana*. This was crammed into the young bird's throat, and he had [xxxii] much trouble in getting it down. I have always imagined (on pure supposition) that *Hypsidæ* were distasteful. If I can see anything more before posting this, I will add it later."

"March 23.

"I have watched the nest at intervals since, but have seen nothing out of the common brought, only larvæ, grasshoppers, spiders and so forth, and berries."

[A later communication from Mr. H. Leslie Andrewes, dated May 4, contained further interesting notes on the habits of these insectivorous birds:—

"The whole thing, as is usual with these silly birds, came to grief a day or two after my observations, as the nest was tied on anyhow to decaying cannas. I fixed it up for them once or twice, but it capsized one night, and the family disappeared. There was *unlimited* food for old and young; the garden was full of grasshoppers (which formed a large part of their food), also caterpillars. For all this, at about every third visit, if not more frequently, the parents stopped to swallow the young birds' excrement. Perhaps I should have made a note of it, but I knew that thrushes did this*—I have seen them do so—and thought it was a more or less

* For an observation of the kind alluded to, see "Nature," vol. lvii, April 14, 1898, p. 554.

universal custom with birds, and so did not mention the fact ; they always swallowed the excrement before flying off. It is a curious habit, and in this case I am sure it was not done from hunger.”]

Professor E. B. POULTON said that the bulbul was probably little affected by properties which were a protection against the majority of insect-eating birds. Mr. Andrewes' observation helped us to a knowledge of the special enemies of specially defended insects, and was further evidence of Haase's error in applying the unqualified term “immune” to any insect, however unpalatable. Monsieur Charles Oberthür had argued “(Études de Lepidoptérologie comparée”: Fasc. ii, Rennes, Oct. 1906, p. 25-27) from cases such as these that there is no significance in any special defence or the accompanying warning (aposematic) colours. This distinguished naturalist, xxxiii]

seeing in nature that every living being served as the food of some other being, arrived at the conclusion that the order of things is fixed and unchanging, and that by sure instincts and keen senses the insect-eating animals found their prey, unhindered by concealment or by any other mode of protection. M. Oberthür believed in short that the very words “concealment” and “protection” only represent an unsound anthropomorphic inference, for, in his opinion, neither concealment nor protection from enemies is ever afforded. From a study of the same struggle for existence the majority of naturalists have come to very different conclusions. They saw evidence for the existence of a balance between the aggressive and protective forces, and believed that in maintaining this balance cryptic colours and warning and mimetic patterns were of essential importance to numberless species. They recognised the usual ultimate success of the enemies of insects, but also saw that this success involved hard work and much time spent in the chase, and that in fact the relationship between pursuer and pursued was precisely of the kind to strengthen the faculties and powers of the one and gradually improve the protective methods of the other.

Professor E. B. POULTON also exhibited two female specimens of *Laphria gilva*, L., captured with prey (Sept. 1906) at

Grinderwald, Hanover, by Dr. Karl Jordan. One female, captured *in coitū*, was devouring the Pentatomid bug, *Dolycoris baccarum*, de G., male; the other was carrying a worker of *Vespa rufa*, L. *Asilidæ* preying upon the formidable Diptera had often been recorded from tropical countries, but never before, so far as the speaker was aware, from Europe.

Professor E. B. POULTON then made the following communication:—

ON THE SPECIES OF NEPTIS IN THE ISLANDS TO THE E. AND THE N.W. OF MADAGASCAR.—My attention was first directed to the interesting and puzzling problem presented by these species by the recent communications of Colonel N. Manders, F.E.S., and by the specimens collected by him in Mauritius and Bourbon. The considerable difference in detail between *Neptis frobenia*, F., of Mauritius, and *N. dumetorum*, Boisd., of

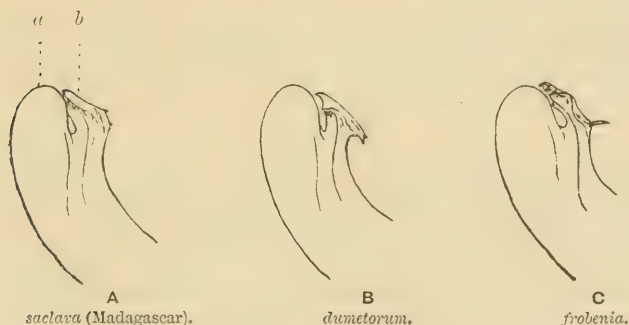
[xxxiv

Bourbon, at first suggested that the two species were not nearly allied, and that their marked superficial resemblance may have been due to mimicry. At the same time any attempt to explain the growth of a mimetic likeness presented the gravest difficulties. The details of the pattern of *dumetorum* indicated close affinity with the black and white *Neptis saclava*, Boisd., of Madagascar and the mainland of Africa; while the much greater simplification, especially on the under surface, of *frobenia*, suggested affinity with the Austro-Malayan species of the group of *N. consimilis*, Boisd. If this interpretation were correct, *frobenia* would take its place beside the species of *Euplœa* as representatives of an Eastern butterfly fauna. Mr. G. A. K. Marshall has, however, carefully examined the neururation of these species, as well as *N. comorarum*, Oberth., from the Comoros, and *N. mayottensis* from Mayotte, and has compared them in this respect with *saclava* and *consimilis*. His results leave no doubt that, as regards this important character, *N. frobenia*, as well as the other three species of *Neptis* in the islands surrounding Madagascar, is closely related to *saclava* and remote from *consimilis*. Mr. Marshall has kindly drawn up the following account of the evidence of affinity based on neururation:—

"*Neptis frobenia*, F., from Mauritius, differs from the superficially similar *N. consimilis*, Boisd., from the Austro-Malayan islands, and agrees with *saclava*, Boisd., in the following neurational characters:—

"In *frobenia* the origin of vein 10 of the fore-wing is much nearer to apex of the cell, so that its distance from that point on the distal side is approximately equal to the distance of vein 11 from the same point on its proximal side. In the hind-wing veins 6 and 7 are very close at their origin, and vein 5 has a sharp curve at its base, representing a rudimentary discocellular.

"In *consimilis* the origin of vein 10 of the fore-wing is much further removed from the apex of the cell, its distance being



almost three times as great as that between vein 11 and the same point. In the hind-wing veins 6 and 7 are appreciably separated at their origin, while vein 5 is scarcely curved at the base, giving the upper edge of the cell a much flatter outline. xxxv]

"In all these characters *frobenia* agrees closely with the other yellow-marked *Neptis* of the African islands that I have examined, viz.: *N. dumetorum*, Boisd., *N. mayottensis*, Oberth. and *N. comororum*, Oberth."

Dr. Karl Jordan kindly consented to investigate the evidence of affinity founded upon the male genital organs. The following account prepared by him entirely supports Mr. Marshall's conclusions, although I was at the time un-

fortunately not able to submit either *comorarum* or *mayottensis* to dissection.

"*Neptis saclava*, Boisd., and its nearest allies differ from the majority of the species of *Neptis* in one very conspicuous character in the genital organs. The clasper of these species is divided by a narrow sinus at the apex into two lobes. The ventral lobe (Fig. A, *a*) is broad and rounded, being almost the same in the various allies of *saclava*. The dorsal lobe (*b*), on the other hand, exhibits easily recognised [specific differences. This lobe is somewhat twisted. In *saclava* (Fig. A) the top of the dorsal lobe lies over the outer surface of the ventral lobe, not being visible in a view from the inner side as here represented. Dorsally the lobe bears a thin ridge which is more or less denticulate. This ridge projects more in Continental specimens (*N. saclava marpessa*) than in Malagasic ones (*N. s. saclava*, Fig. A): The specimens dissected show some individual variability in the shape of the lobe.

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"*N. nemetes* as well as *metella* have a similar though not identical clasper, agreeing in this respect better with *N. saclava* than do *N. dumetorum* and *frobenia*.

"In *dumetorum* (Fig. B) the dorsal lobe is almost half-crescent-shaped when looked at from the apical side, the dorsal surface of the lobe being much wider than in *N. saclava*, and the dorsal angle of the lobe projects much more than in *N. saclava*. I have examined two ♂ ♂.

"In *frobenia*, of which I have examined only one specimen, the lobe is more compressed than in *N. dumetorum*. The apex of the lobe is dentate and the dorsal angle is produced into a thorn-like process.

"I may add that the tawny Oriental *Neptis* have quite a different clasper, the similarity in colour with *frobenia* and *dumetorum* being superficial. I have not been able to examine *N. comorarum* and *mayottensis*."

This convergent evidence renders it certain that the four tawny-marked species of *Neptis* in the islands surrounding Madagascar, are all closely related to one another and to the white-marked *saclava* in Madagascar itself. The next point

which required clearing up was the distribution ; for although each tawny species is known to exist in a separate island (or perhaps group of islands in the case of *comorarum*), outside Madagascar, *frobenia* and *dumetorum* have both been stated to occur in Madagascar as well. In settling this point it was convenient to decide with it the precise distribution of the species of *Euplœa* in the outlying islands, for some of these have also been affirmed to exist in Madagascar. Upon this subject Monsieur Charles Oberthür can speak with greater authority than any living naturalist, and he has kindly answered my questions in detail. Writing on April 30th and May 4th, he says :—

“*Neptis dumetorum*.—Tous les exemplaires que j’ai vus viennent de l’île Bourbon. Jamais je n’ai vu *dumetorum* provenant d’une autre localité.

“*N. comorarum*.—Tous les exemplaires ont été pris aux Comores ; jamais ailleurs.

“*N. mayottensis*.—J’ai reçu seulement un petit nombre pris à Mayotte. Toujours *mayottensis*.”

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Concerning *frobenia* he writes :—“Jamais *Neptis frobenia* n’a été rencontré à Madagascar—du moins d’après ce que je connais—mais seulement à l’île Maurice.”

“Quant aux *Euplœa*, je crois *goudoti* spéciale à l’île Bourbon ; *euphone*, à Maurice ; *desjardinsi*, à Rodriguez ; et *mitra*, aux Seychelles. Je possède les 4 espèces. Mais jamais je n’ai reçu aucun exemplaire de *goudoti*, ou *euphone* à Madagascar.”

I am also informed by Mr. H. Grose-Smith, F.E.S., that he has never received any of the following species from Madagascar :—*Neptis dumetorum*, *N. frobenia*, *Euplœa euphone*, and *E. goudoti*. The erroneous statements as to the occurrence in Madagascar of certain species of *Euplœa* and *Neptis* confined to the outlying islands, are probably due to Mabile ; but they are unfortunately repeated, although sometimes queried, by Aurivillius.

Each of the four outlying forms of *Neptis* may therefore be looked upon as the product of its own island, and a very interesting problem of evolutionary history is presented to us. One great difficulty in attempting its study was the want of

specimens from the Comoros and Mayotte. So far as I am aware the single specimen of *mayottensis* in the British Museum is the sole example of these two forms, in this country. I therefore wrote to Monsieur Charles Oberthür, of Rennes, asking for information concerning the pattern of *comorarum*. With great generosity my kind friend at once presented to the Hope Collection the interesting examples of *comorarum*, *mayottensis*, *dumetorum*, and the Madagascar form of *saclava* which are now exhibited. The two specimens of *comorarum* and the *mayottensis* formed part of the collection made by L. Humblot (1885-6).

Comparing the four species it is at once evident that the eastern pair *dumetorum* and *frobenia*, are related together and quite distinct from the north-western pair, *mayottensis* and *comorarum*, which are even more closely related to each other. Furthermore, as we should expect from their more isolated position, the eastern species are far more distantly removed from the Madagascar *saclava* than the north-western; while in each pair the species from the outer island is far more remote from *saclava* than the species in the island which is [xxxviii

nearer to Madagascar. *Mayottensis* indeed appears to be so near to *saclava* that there is practically nothing but colour to separate it. In the British Museum it is accorded subspecific rank only. Its close affinity to *saclava* was pointed out by Oberthür in the original description.

So far as it is possible to infer from a very limited number of specimens in a group where individual difference in size is strongly marked, *dumetorum* is the largest of the five species, then *saclava*, then *frobenia*, while the two north-western species, which appear to be about equal in size, are the smallest.

The tawny markings of the upper surface are much deeper in tint in the eastern species: *frobenia* is in this respect slightly but distinctly darker than *dumetorum*. *Comorarum*, on the other hand, is almost precisely of the same pale tawny shade as *mayottensis*. It may be faintly deeper in tint, but I could not feel certain of this. The ground-colour is blackest in *dumetorum*: in *frobenia* it is of a much duller browner shade.

In the north-western species the relative shape and proportions of the chief markings on the upper surface are very similar to each other and to the white markings of the Madagascar *saclava*. In *comorarum*, however, the band of the hind-wing is considerably narrower, and is not prolonged on to the fore-wing as it is in all the other species of this group. This extension on the fore-wing is largest in *saclava* and *mayottensis*, smaller in *dumetorum*, and still smaller but quite distinct in *frobenia*. In the eastern species the band of the hind-wing is not only still narrower, but possesses, in *dumetorum*, a markedly crenulate outer margin which gives it a very distinct appearance. In some individuals of *frobenia*, slight but obvious traces of this outline are a further indication of affinity between it and *dumetorum*. Each crenulation occupies an internervular space, and is concave in form. In *saclava*, on the contrary, the outer border of the band projects as more or less of a convexity into each internervular space. The difference may be expressed by saying that the outer margin of the band is formed of concave crenulations in *dumetorum*, of convex crenulations in *saclava*.

As regards the markings of the under surface and of the xxxix]

upper (notwithstanding the one distinguishing feature described above), *comorarum* is far nearer to *saclava* than is *frobenia* or even *dumetorum*. In the north-western species the markings on the under surface are paler than those of the upper, while the minute markings are lighter than the larger. The under side of *dumetorum* is remarkable in the fact that the chief spot of the fore-wing is fulvous while the other markings and those of the hind-wing are white. Indications of the same contrast exist, although far less developed, in *frobenia*.

These are the chief characteristics of colour and pattern which distinguish the four island species from one other and from the Madagascar *saclava*. It is of great interest to attempt the difficult task of reconstructing some stages of the past history of the group. We may confidently assume, from the greater affinity to *saclava* on the innermost island on each side, that all the four forms were derived from Madagascar; and, if amount of change be a measure of period of isola-

tion, that *frobenia* was first isolated, *dumetorum* second, *comorarum* third, and *mayottensis* fourth. We must if possible distinguish in each case between ancestral characters which have persisted from a period previous to the isolation, and recent characters which have been evolved since its beginning. The former are of special interest in that they suggest to us some of the features which *saclava* has now lost in Madagascar.

a. ANCESTRAL FEATURES.—1. *The Band Crossing the Hind-Wing.*—*Saclava* in Madagascar has a considerably broader band than on the mainland of Africa. It is probable that the Madagascar *saclava* also formerly possessed a narrower band, which still persists in three out of the four island forms. It is probable that the band of *saclava* has been widened in consequence of synaposematic approach to the other species of *Neptis* in Madagascar, and perhaps partially under the influence of *Amauris nossima*, Ward, in which the white markings are so strongly developed. The synaposematic sensitiveness of *Neptis* to the African species of *Amauris* as well as to other *Danaïnae* in other regions has been referred to in Trans. Ent. Soc. Lond. 1902, pp. 467–8. *Neptis kikideli*, Boisd., of Madagascar, described as a common species by Mabille, is distinguished by a great development of the white markings, and

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Mr. Grose-Smith informs me that he possesses an allied undescribed species from the same island with even broader bands, especially upon the posterior wings. Furthermore *Neptis metella*, D. and H., is represented in Madagascar by the form *gratilla*, Mab., in which, as in *saclava*, the white markings are larger than in the African form. Another black and white species, *N. searilla*, Mab., is unknown to me. There is therefore clear evidence of the existence in Madagascar of a powerful combination in which the white markings are especially well developed.

2. *The Tawny Markings of the Island Species.*—It is difficult to decide between the two alternative interpretations of the difference in colour between *saclava* and the four species in the outlying islands. If white markings are ancestral in *saclava* it follows that the tawny colour has been evolved independently in the north-western and eastern species.

Furthermore we have no cause to assign for the change except the vague and unsatisfactory one of isolation. The relationship of the two north-western species is also opposed to this interpretation. We may infer from the differences between them that *comorarum* has been isolated for a much longer period than *mayottensis*, and yet the tint of their yellowish markings is almost precisely the same. It therefore appears to me more likely that *saclava* formerly possessed in Madagascar, and probably also in Africa, markings of a tawny colour, and that these have been gradually changed to white on both areas as the result of a synaposematic approach to other black and white species of *Neptis*. The four outlying species did not encounter any such causes of change. According to this hypothesis the eastern species represent an early emigration when the markings of *saclava* were of a deep tawny tint, while the north-western species represent a much later phase when they were far advanced towards white. Mimetic approach commonly advances more rapidly in the female sex; and the faint cream tint of the male *saclava* may be a lingering trace of an earlier tawny shade. The difference between the pale markings of male and female is, however, so minute that a long series of fresh specimens should be compared before it can be accepted as firmly established. If the suggestion made xli]

on p. vi that *Libythea cinyras*, Trim., is a mimic of *Neptis frobenia* be sound, it would support the conclusion that the tawny markings are of great age.

b. CHANGES SUBSEQUENT TO ISOLATION.—Although it is evident that the two north-western species are specially related together, and the two eastern species also specially related, so that they represent two distinct emigrations from Madagascar, it is nevertheless true that more complete and probably far longer isolation in the outermost island has been followed by certain changes which have much in common on the two sides. In some characters the north-westernmost *N. comorarum* differs from *N. mayottensis* in much the same way that the easternmost *frobenia* differs from *dumetorum*. Both east and west of Madagascar the more remote and isolated species has undergone simplification in the details of

pattern and outline, shown in a reduction of the undulations of the outline, the comparative obscurity of the marginal and submarginal pattern, and in the loss or faint development of minute details in the pattern of both surfaces, especially the under. This last effect is far more evident in *frobenia*. In one feature, however, the upper surface of *comorarum* departs further from *mayottensis* than *frobenia* from *dumetorum*, viz. in the loss of the mark on the inner margin which, in other species of the *saclava* group, prolongs the band of the hind-on to the fore-wing. This is an isolated feature; for in the retention of minute white points in the cell of the fore-wing upper surface and in the whole pattern of the under surface, *comorarum* is immensely nearer the *saclava* group than *frobenia* or even *dumetorum*.

The pronounced simplification which has occurred in the two most isolated species has been accompanied by a remarkable persistence in the larger and more conspicuous elements of the pattern, so that during flight or at rest with wings expanded, *frobenia*, at a little distance, would closely resemble *dumetorum*, and *comorarum*, under similar circumstances, *mayottensis*.

Such are the changes which have taken place in the two most isolated species of this group of *Neptis*, and it is important to separate sharply the remarkable and interesting

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facts from any attempt—in this case peculiarly difficult—to explain the causes.

The minutiae of an aposematic pattern such as that of *Neptis* may well be kept up by selection on an area where two or more species exist together, and where *e.g.* an elaboration of the marginal markings is common to all. Under these circumstances, too, elaboration would probably be gained by a species with simpler pattern brought by migration into the area in question. When, however, an aposematic species with elaborate pattern becomes isolated, we should expect, on the very same principles that are believed to account for the growth of Müllerian resemblances generally, that enemies would continue to test with especial severity large departures from the average specific pattern. But in this case the

numbers composing the average, being made up of the majority of the individuals of but a single species, would exert an influence less powerful than that of the far larger number contributed by two or more species. If this reasoning be sound we should expect that a less searching selection would permit departures in minute detail, while it would still cut off large and conspicuous departures from the average. Thus, perhaps, may be explained the simplification in detail and persistence of general effect. It would furthermore follow as a general conclusion that after isolation aposematic patterns would tend to be kept more constant than others. Against this tendency must be set the special liability of aposematic species to enter fresh combinations—a tendency of course held in check in these small outlying islands.

A discussion on the change of coloration in insular forms of this and other lepidoptera followed, in which Dr. T. A. CHAPMAN, Mr. G. A. K. MARSHALL, the Rev. G. WHEELER, Col. N. MANDERS and other Fellows participated.

MIMICRY IN BOURBON BUTTERFLIES.—Lieut.-Colonel N. MANDERS exhibited a collection of butterflies from Bourbon demonstrating examples of mimicry and the effects of the interaction of species. At a previous meeting of the Society he had exhibited a series of the *nireus* group of *Papilios* from Africa, Madagascar and the neighbouring islands, in which he pointed out that whereas both sexes were of some shade of green xliii]

and therefore resembled each other, in Bourbon the female of the indigenous species (*P. phorbanta*) was brown and quite unlike the male. He attributed this to the effects of mimicry, *Euplexa goudoti* being the model. It had since been suggested to him by Professor Poulton and Mr. Trimen that *Euplexa euphon* resembled both *P. phorbanta* and *Salamis angustina* far more closely than *E. goudoti*, and they were of opinion that this had been the model for the two species. Against this view was the fact that *E. euphon* was strictly confined to Mauritius, and no record of its occurrence in Bourbon was forthcoming. This undoubtedly closer resemblance of *euphon* had led him to further investigate the matter, and there appeared to be two hypotheses to account for its disappearance:

either *goudoti* was a modified descendant of *euphon*, or in some way it had replaced it. With regard to the first point he showed essential differences between the two; *goudoti* being more closely connected with that group of *Euplœas* placed by Moore in the genus *Vadebra*, and *euphon* with those in his genus *Nipura*. He then discussed the possibly Malayan origin of *goudoti*, and remarked more particularly on its extraordinary resemblance to *E. woodfordi* from the Solomon Islands, and expressed the opinion that all the *Euplœas* of this group were derived from the same ancestral type, and suggested *E. climena* from Amboina and Ceram as being nearest to it. He dealt with the former history of Mauritius and Bourbon, and explained that both during the Dutch and French occupation in the seventeenth and eighteenth centuries a large number of Malayan plants were introduced into those islands, and that inasmuch as the voyage from Java was only of three weeks to a month's duration, there was no inherent improbability of *E. goudoti* being brought to Bourbon by one of the Dutch or French ships. He concluded by describing the physical characteristics of the island, and said that the area favourable for the existence of *Euplœas* was extremely small, and as the larvæ of *goudoti* and *euphon* fed on the same plants there was in all probability a struggle for existence set up in which the invader proved the stronger and eventually exterminated its rival.

Professor POULTON desired to congratulate Colonel Manders [xliv for the careful manner in which he had worked up the evidence bearing upon his brilliant suggestion. As one who had arrived at an alternative interpretation—viz. that *goudoti* represented a recent modification of *euphone* in the island of Bourbon—he desired to express his agreement with Colonel Manders, and his conviction that the most probable solution of a puzzling set of facts had been afforded by the hypothesis he had so clearly explained to them that evening. He also remarked that in the neighbouring island of Rodriguez there was a species of *Euplœa* (*desjardinsi*) greatly resembling *euphon*, and no doubt a geographical race of that species. This fact, he considered, also suggested that *euphon* formerly existed in Bourbon.

TYPES OF OXYGAstra.—Mr. LUCAS also brought for exhibition the ♂, ♀, and nymph of the dragonfly *Oxygastra curtisii*, first described by the late J. C. Dale, and at that time supposed to be confined to the British Islands.

Papers.

Mr. W. J. LUCAS, B.A., read a paper on "The British Dragonflies of the 'Dale Collection.'"

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Wednesday, June 3rd, 1908.

Dr. J. L. HANCOCK, M.D., communicated a paper on "Further studies of the *Tetriginæ* (Orthoptera) in the Oxford University Museum."

Mr. J. C. MOULTON read a paper on "Mimicry in Tropical American Butterflies."

Professor E. B. POULTON, F.R.S., read a paper on "Heredity in *Papilio dardanus* from Natal, bred by Mr. G. F. Leigh, F.E.S., of Durban," and exhibited, in illustration, a large series of the forms of *P. dardanus* from Natal and Chirinda.

EXTRACTS FROM THE PROCEEDINGS
OF THE
ENTOMOLOGICAL SOCIETY OF LONDON

(OCTOBER 7TH—DECEMBER 2ND, 1908).

—○—
Wednesday, October 7th, 1908.

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Exhibitions.

MIMICRY OF THE *melpomene*-LIKE *Heliconii* BY OTHER GROUPS OF SOUTH AMERICAN BUTTERFLIES.—DR. F. A. DIXEY exhibited specimens of Neotropical butterflies belonging to the Erycinidæ, Acraeidae, Heliconiinae, Nymphalinae, Pierinae and Papilioninae, and remarked upon them as follows:—

“On March 18 last, Mr. W. J. Kaye, in exhibiting three species of the Pierine genus *Pereute*, together with specimens of the Nymphaline *Adelpha lara*, Hew., called attention to the fact that these species, which all bear a general resemblance to each other, are found together in the Chancamayo district of Peru at an elevation of from 2500 to 3000 feet. He added that it was wrong to suppose that any *Heliconius* of the *melpomene*-like group entered the combination, inasmuch as *Heliconii* of this pattern did not ascend to such an elevation, or if they did, it was only as a rare exception. For the like reason Mr. Kaye thought that my suggestion, made in 1896 (and previously in 1894), of an association between *P. leucodrosime* and *H. melpomene* was ‘an impossible conclusion.’

“I am of course perfectly ready to accept the testimony
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brought forward by Mr. Kaye as to the spatial relations of these forms in the district named, but I observe with interest that in a note to the record of his exhibition in our recently-published ‘Proceedings’ (Proc. Ent. Soc. Lond., 1908, p. xxiii), he mentions the fact that according to Seitz, ‘in Colombia *Pereute leucodrosime*, *Papilio euterpinus*, *Adelpha isis* and *Heliconius melpomene* all occur together on the same

bush.' This obviously discounts the value of the observations made in Peru, considered as evidence of the exclusion of *Heliconius* from the mimetic combination. No stress need be laid on the mention of *H. melpomene* instead of one of the forms which so closely resemble it, as for instance *H. hydarus*, inasmuch as before the publication of Riffarth and Stichel's excellent systematic work on the genus, many of the *melpomene*-like forms were but vaguely distinguished from one another; and even now it is very probable that by those who do not happen to have made a special study of the genus, forms are inadvertently spoken of as *melpomene* which are really quite distinct from that species as at present defined. In 1896 I used *H. melpomene* as an illustration; but in the earlier passage then referred to, I spoke of the resemblance as being shared by many species of *Heliconius*, including *H. hydarus* (Trans. Ent. Soc. Lond., 1894, p. 294 and note; *ibid.*, 1896, pp. 72-75). The argument, whatever it may be worth, would of course remain unaffected even if it were shown that species had been wrongly identified.

"But leaving this part of the question, I wish to draw attention to the very wide prevalence of this general type of pattern (a dark wing-surface crossed by a diagonal reddish band) in the Neotropical region, as exemplified by the specimens I now exhibit. Opinions may differ as to how far these various forms are in mimetic relation; that such a relation exists between some at least of them will I think be generally admitted. For instance, the mimetic parallelism between the two sections of *Heliconius*, which Mr. Kaye has so fully demonstrated to us (Proc. Ent. Soc. Lond., 1907, pp. xiv-xvi), seems to be undeniable. The relation also between the *Papilio* and the Pierines in this exhibit can scarcely be doubted. It is true that the latter combination, which, as Mr. Kaye says, is

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no doubt mainly an upland assemblage, falls somewhat apart in aspect from the *melpomene*-like *Heliconii*, but it is to be observed that the latter are not entirely confined to the lowlands. Two species from Ecuador here shown (*H. vulcanus* and *H. cyrbia*) are from series captured at an elevation of 3500 feet, which is quite high enough for any *Pereute*. Still more important is

the fact that many other forms are seen to exist which may very well bind together the inhabitants of the heights and of the plains in one mimetic assemblage; the *Catagrammas*, for instance, are stated to occur at all elevations. Another fact to be borne in mind is that the distribution and movements of the enemies have to be taken into account as well as those of their prey; and until we know for certain that these enemies are similarly limited in their range, we cannot well exclude the possibility of the extension of the mimetic influence of a given species beyond its own area of distribution.

"It may be remarked, in conclusion, that the 'aposeme' shades off in various directions; one of them being probably exemplified by the Erycinids exhibited, and another by the *Actinotes*."

The species shown were—

ERYCINIDÆ.

<i>Erycina inca</i> , Saund.	Panama.
<i>Panara phereclus</i> , Linn.	Brazil.
<i>Aricoris</i> , sp.	

ACRÆINÆ.

<i>Actinote stratonice</i> , Latr.	Colombia.
<i>A. trinacria</i> , Hew.	Ecuador.

HELICONINÆ.

A. *Heliconius amaryllis*, Feld.
euryades, Riff.

Trinidad, Venezuela,
Colombia, Peru.

H. melpomene, Linn.

Guiana, Amazon, Peru,
Ecuador.

H. vulcanus, Butl.

cythera, Hew.

Ecuador.

B. *H. hydarus*, Hew.

guaricus, Reak.

Colombia, Venezuela.

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H. hydarus, Hew.

Trinidad, Central
America, Colombia.

H. erato, Linn.

magnificus, Riff.

Guiana, Peru, Ecuador.

H. amphitrite, Riff.

Peru.

H. cyrbia, Godt.

Ecuador

NYMPHALINÆ.

<i>Catagramma denina</i> , Hew.	Guatemala to Ecuador.
<i>C. pasithea</i> , Hew.	Peru.
<i>C. eunomia</i> , Hew.	Amazon.
<i>C. parima</i> , Hew.	Colombia, Ecuador.
<i>Adelpha lara</i> , Hew.	Colombia, Peru.
<i>Eresia castilla</i> , Feld.	Colombia, Ecuador.
<i>Agrias amydon</i> , Hew.	Colombia.

PIERINÆ.

<i>Pereute charops</i> , Boisd. ♀.	Central America, Colombia, Ecuador.
<i>P. callinice</i> , Feld.	Colombia.
<i>Catasticta teutamis</i> , Hew. ♀.	Ecuador, Peru.

PAPILIONINÆ.

<i>Papilio euterpinus</i> , Godm. and Salv.	Colombia, Ecuador.
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C. teutamis ♀ and *P. euterpinus* were represented by coloured drawings.

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Papers.

Dr. G. B. LONGSTAFF, M.D., read a paper on "Bionomics of Butterflies."

Wednesday, October 21st, 1908.

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SPECIFIC IDENTITY OF TWO FORMS OF CHARAXES FROM SOUTH AFRICA.—Professor E. B. POULTON, F.R.S., exhibited a series of seven *Charaxes neanthes* and one *C. zoolina*, all reared by Mr. G. F. Leigh, F.E.S., from the eggs laid by a single female *neanthes*. He said that, although the evidence as it stood was not entirely convincing, the independent experience of other naturalists rendered it in the highest degree probable that the conclusions suggested by the presence of the single *zoolina* in the family of *neanthes* were sound and permanent. Mr. Leigh's account of his interesting discovery was as follows:—

Charaxes neanthes, Hew. (1854), a form of *C. zoolina*, Westwood (1850).

Having in January 1905 bred from the same larvæ, or

what I took to be the same larvæ, both *Charaxes zoolina* and *C. neanthes*, although so different, I determined if possible to obtain ova and try to rear them. On 18th May, 1908, I followed up a ♀ *C. neanthes*, and obtained 18 ova, and should have obtained more, but the insect was then captured by a bird. All hatched on the 23rd and 24th May, and I put the larvæ on their food-plant, an Acacia, *Entada natalensis*, but was very unfortunate with them, no less than 9 dying during the 1st and 2nd stages. The leaves fold up at night, but open again in the wild state, but when picked and put in water they do not open: this I believe was the cause of the mortality; for I was obliged to keep taking the larvæ off the old food and putting them on to new. The 9 remaining larvæ thrive and 8 became pupæ. One larva I preserved, and have sent with the insects, as also the empty pupa-cases. The *C. zoolina*, a female, was the 3rd to emerge, and I give full particulars of the emergence from pupæ. In January next I will breed again from *C. zoolina* ♀, as this form is then more plentiful than in lxv]

August, and I also hope to obtain a larger number of ova. All the 8 specimens now sent are midgets, owing to the larvæ being starved in July, because, in consequence of ill-health, I was unable to get them fresh food often enough. The times of pupation and of emergence were as follows:—

1. <i>C. neanthes</i> ♂	Pupated	4/8/08	Emerged	17/8/08.
2. " ♂	"	6/8/08	"	18/8/08.
3. <i>C. zoolina</i> ♀	"	5/8/08	"	18/8/08.
4. <i>C. neanthes</i> ♂ Cripple	"	6/8/08	"	19/8/08.
5. " ♂	"	7/3/08	"	20/8/08.
6. " ♀	"	8/8/08	"	23/8/08.
7. " ♂	"	10/8/08	"	26/8/08.
8. " ♂	"	11/8/08	"	28/8/08.

I may mention that Mr. E. L. Clark, F.E.S., of Congella, bred 2 *zoolina* and 4 *neanthes* in January this year from what he took to be the same larvæ.

G. F. LEIGH, F.E.S.,
Durban, Natal.

Professor POULTON said that he had submitted Mr. Leigh's paper to Mr. G. A. K. Marshall, who had replied as follows:—

London, Oct. 8, 1908.

“Leigh's results with *Charaxes neanthes* are extremely interesting, but I am not at all surprised to hear of them. I have always been struck by the very close relationship of this form to *zoolina*, and at one time thought they might be seasonal forms one of the other; but such dates as I could obtain did not seem to quite agree with that idea.”

Professor POULTON observed that the far more cryptic under surface of *neanthes*, together with its general colouring, suggested a dry-season form. He had asked Mr. Marshall for his experience of the duration and succession of the wet and dry seasons in Natal, and his friend had kindly supplied the following account:—

The early rains begin about mid-August and the wet season proper in mid-September, continuing until mid-March.

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Then follows a month of showers until mid-April, when the dry season proper begins. In Durban showers are liable to occur occasionally in the dry season.

Mr. Roland Trimen, F.R.S., gives in his “South African Butterflies,” December, January, April to August, and especially May, as the times of appearance of *neanthes* in Kaffraria Proper, and for *zoolina* in the same locality, autumn, and not after the beginning of April.

The following dates of capture of these two forms in various localities have been copied from the labels accompanying the specimens in the Hope Department.

NATAL.

Captured by G. A. K. Marshall at and near Durban, Natal.

Durban	April 4, 1896	<i>zoolina</i>	♂.
Malvern, 800 ft.	March 10, 1897	<i>neanthes</i>	♂.
“	“	March 27, “	“
“	“	April 1, “	“
Durban	May 2,	“	♂.
“	May 2,	“	♂.
“	May 9,	“	♀.

S.E. RHODESIA.

Captured at Chirinda Forest, Melsetter, Gazaland (3800 ft.),
by G. A. K. Marshall and C. F. M. Swynnerton.

Sept. 27, 1905, *neanthes* ♀ (G. A. K. M.)

March 1-6, 1907, *zoolina* ♀ (C. F. M. S.)

March 12, „ „ ♀ („ „)

April 10, „ „ ♀ („ „)

N.E. RHODESIA.

Captured by S. A. Neave at Petauke, East Loangwa district,
N.E. Rhodesia : 2400 feet.

March 13, 1905 { 1 *neanthes* ♂
 1 *zoolina* ♂

March 30, 1905 1 „ ♀

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BRITISH EAST AFRICA.

a. *Coast District.*

Captured by Rev. K. St. Aubyn Rogers at Mangea, about
75 miles N. of Mombasa : about 500 feet.

July 18, 1906 1 *neanthes* ♂

b. *Taita.*

Captured by Rev. K. St. Aubyn Rogers at Dabida Mountain,
Taita, British East Africa : about 4800 feet.

May 25, 1904 2 *zoolina* ♂

May 28, 1904 1 „ ♀

May 31, 1904 1 *neanthes* ♂

June 11, 1904 1 *zoolina* ♂

c. *Taveta.*

Captured by Rev. K. St. Aubyn Rogers, etc., at Taveta,
British East Africa : about 2500 feet.

April 19, 1905 1 *zoolina* ♂

May 1, 1905 1 „ ♂

May 4, 1905 1 „ ♂

May 6, 1905 1 „ ♂

May 8, 1905 1 „ ♂

May 10, 1905 1 „ ♂

May 12, 1905 4 „ 3 ♂ 1 ♀

May 17, 1905	3 <i>zoolina</i>	1 ♂	2 ♀	
May 22, 1905	{ 1 " ♂ 1 <i>neanthes</i> ♂			
May 1-31, 1905	{ 8 <i>zoolina</i> 4 ♂ 4 ♀ 3 <i>neanthes</i> 2 ♂ -1 ♀			Presented by C. A. Wiggins. Collected by native.
July 1, 1905	1 " ♂			
Jan. 19, 1906	1 <i>zoolina</i>		♀	

d. *Nairobi*.

Collected by A. H. Harrison : 5500 feet.

March 10, 1903	. . .	1 <i>neanthes</i>	♂	
May 17, 1903	. . .	7 " 6 ♂	1 ♀	

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e. *N.E. shore of Victoria Nyanza*.

Collected by C. A. Wiggins and A. Vincent near Kisumu : 3770 feet.

Dec. 1, 1902	. . .	{ 1 <i>zoolina</i> ♂ (C. A. W.) 1 <i>neanthes</i> ♂ (C. A. W.)	
Dec. 8, 1902	. . .	1 " ♂ (C. A. W.)	
March 25, 1903	. . .	1 " ♀ (C. A. W.)	
March 27, 1903	. . .	3 " ♂ (C. A. W.)	
Aug. 1-15, 1903	. . .	3 " ♂ (C. A. W.)	
Oct. 15, 1903	. . .	1 " ♂ (A. V.)	
Nov. 1903	. . .	{ 2 " ♂ (A. V.) 1 <i>zoolina</i> ♂ (A. V.)	

Collected by C. A. Wiggins, at Kalachonyo, 20 miles S. of Kisumu : 3800 feet.

Dec. 19-27, 1902	1 <i>neanthes</i>	♂	
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Collected by A. H. Harrison, at Kamagombo, S. Kavirondo.

Jan. 24, 1903	1 <i>neanthes</i>	♀	
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In addition to the above there are 16 *zoolina* (4 ♂ 12 ♀) and 2 *neanthes* (1 ♂ 1 ♀) collected in British East Africa by Mr. A. H. Harrison. These are without further data of time and place.

The above series of specimens shows a reversal in the proportions of the two forms in the northern part of the range. Thus in British East Africa the more conspicuous *zoolina* appears generally to preponderate over the more cryptic *neanthes*, while in Natal the converse relationship holds. We are reminded of *Precis archesia* in which also the more conspicuous form *pelasgis* is abundant in the north, while the far more cryptic form, *archesia*, is apparently rare.

If the two forms of *Charaxes zoolina* are seasonal it is evident that they are by no means confined to their respective periods of the year.

Dr. KARL JORDAN stated that he was not at all surprised at Mr. Leigh's results; for there were no structural differences between *zoolina* and *neanthes*. He also said that other forms in the same genus would doubtless require to be united in

[lxix] the same manner. The following account was subsequently prepared by Dr. JORDAN:—

The experience gained by Mr. Leigh throws new light on quite a number of forms of *Charaxes*. There are two *Charaxes* of this group in Madagascar, *betsimisaraka* representing the African *zoolina*, and *betanimena* representing *neanthes*. These two Malagasic forms both differ in the same way from the corresponding African *Charaxes*, which is additional evidence for the correctness of the result of Mr. Leigh's experiment in breeding. Further evidence is afforded by four West African *Charaxes*, two of which have the facies of *zoolina*, while the two others correspond in colour to *neanthes*. These four *Charaxes* belong doubtless to but two species instead of four, each species being dichromatic. One pair of forms is apparently the West African sub-species of *Charaxes zoolina*, while the other pair are a species distinct from *Ch. zoolina*. As the *zoolina*-form of the West African sub-species has no name I propose to call it

form *phanera*.

It differs from the greenish and black *zoolina* of South and East Africa mainly in the costal margin of the fore-wing being less extended black, in the hind-wing bearing a distinct pointed tail at the lower radial (as in *ehmkei*!), and in the

under side of the same wing having distinct whitish admarginal spots between the costa and second radial.

Type of name: Canhoca, Angola (5, xii. 03, Dr. Ansorge).

The following table shows the relationship of the various forms in question according to the result of Mr. Leigh's experiment. I add that we cannot find any structural differences between the forms here united under *Charaxes zoolina*, and that apparently there is also no constant structural character by which *Ch. ehmkai* could with certainty be distinguished from *Ch. zoolina*.

1. *Charaxes zoolina*, Westw. (1850).

a. *Ch. z. ehmkai*, Dew. (1882).

a¹. form *ehmkai*, Dew., tawny and white; known form Northern Angola.

a². form *phanera*, nov., greenish and black; known [lxx

from Northern Angola, found by Dr. Ansorge at the same time (late in November and early in December) and the same place (Canhoca) as the preceding.

b. *Ch. z. zoolina*, Westw. (1850). Both forms found from Natal northward to Uganda and Abyssinia.

b¹. form *neanthes*, Hew. (1854), tawny.

b². form *zoolina*, Westw. (1850), greenish and black.

c. *Ch. z. betsimisaraka*, Lucas (1872). Both forms from Madagascar.

c¹. form *betanimena*, Lucas (1872), tawny.

c². form *betsimisaraka*, Lucas (1872), greenish and black.

2. *Charaxes kahldeni*, Homeyer (1882).

a¹. form *homeyeri*, Dew. (1882), tawny and white; known from Pungo Andongo, Angola.

a². form *kahldeni*, Homeyer (1882), greenish and black; known from Northern Angola, the Upper Congo, and Southern Cameroons.

Herr A. von Homeyer obtained *kahldeni*, *homeyeri* and *ehmkai* at Pungo Andongo in Northern Angola. Very few specimens of *homeyeri* seem to be contained in collections (we

have only a pair from the Homeyer collection), while *kahlbeni* has more frequently been obtained in several districts.

Professor POULTON remarked that it was extremely interesting and inspiring to see so much new light thrown on this important genus as the result of Mr. G. F. Leigh's experiment.

Paper.

Dr. F. A. DIXEY, M.A., M.D., read a paper, illustrated by lantern slides, "On Müllerian Mimicry, and Diaposematism. A Reply to Mr. G. A. K. Marshall." A discussion followed on the whole subject, in which Mr. R. SHELFORD spoke in favour of Mr. Marshall's views, and Professor E. B. POULTON, F.R.S., in favour of Dr. DIXEY's contentions. Later Mr. G. A. K. MARSHALL communicated the following reply to Dr. DIXEY:—"Having unfortunately been prevented by illness from attending the reading of Dr. Dixey's long-expected paper in lxxi]

reply to my criticisms of his hypothesis of Diaposematism, it is obviously impossible for me to make any adequate rejoinder at present. But there is one point to which I should like to reply immediately. When my paper was read in March last, Dr. Dixey in the course of the few remarks that he made afterwards stated that I had 'given myself away rather badly' on one or two points, though the nature of my supposed blunders was in no way indicated. I now learn that the principal point upon which I am supposed to have 'given myself away' is that I have assumed that it is an essential feature of the hypothesis of Reciprocal Mimicry that the two inedible forms should mimic each other *simultaneously*. Now, I understand that this suggestion is repudiated by Dr. Dixey, who further claims that the hypothetical kind of mimicry which I have called Alternating Mimicry (Tr. Ent. Soc. 1908, p. 103) is merely part and parcel of his own hypothesis of Diaposematism. I may here explain that the idea of Alternating Mimicry is based on the supposition that where two inedible species of practically similar distastefulness are mimetically associated then the mimetic approach will be in one direction only, and will be determined by the relative numbers of the two forms. If A be numerous and B much less so, then B will mimic A; and if sub-

sequently through other causes the relative numbers of the two forms became reversed, then B would cease to mimic A, and provided always that the necessary variations arose, A would begin to mimic B. The resulting interchange of characters is what I should call Alternating Mimicry.* Let us now examine what Dr. Dixey has actually said with regard to the nature of the mimetic approach in the case of his Reciprocal Mimicry. In Tr. Ent. Soc. 1894, p. 297, he defines Reciprocal Mimicry as being produced by 'A and B converging to a point between them,' and further on the same page describes the process as '*mutual convergence*' (the italics are his). On p. 298, foot-note, he points out specially that he does not use 'convergence' in Professor Poulton's sense, namely, as signifying the assimilation of one form to another,

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but as meaning 'the mutual' approach by two forms to a mean between them.' In Tr. Ent. Soc. 1896, p. 74, he refers to his conception as 'a kind of give-and-take arrangement, in consequence of which two or more inedible forms may hasten the assimilative process by imitating each other;' and of course such hastening can only take place when the approach is simultaneous. In Tr. Ent. Soc. 1897, p. 324, we are informed that 'the benefit of Müllerian Association being mutual, there is a distinct reason . . . for the model to help on the process of assimilation by *itself advancing to meet* the mimic' (the italics are mine). But in order that there may be no possibility of a misapprehension Dr. Dixey in the same paper (p. 328) gives a very precise definition as to what we are to understand when he uses his term Reciprocal Mimicry. This expression, he says, 'is meant to convey, besides the general idea of convergence, the special information that in the cases to which the term is applied, the convergence is brought about *not by the simple imitation of one form by another*, but by the interchange of features between forms and their consequent *simultaneous approach* to an intermediate position' (the italics are mine). Now unless we are to interpret words in a distorted sense, it seems to me that the above passages must assuredly convey the definite idea that Reciprocal Mimicry

* Strictly speaking, Diaposematism is a term more applicable to this form of Mimicry than to Reciprocal Mimicry.

involves the conception of a mutual *simultaneous* approach on the part of two species. Indeed, from the last-quoted definition, we may legitimately infer, that whatever he may think now, Dr. Dixey *then* considered that simultaneous approach was the natural consequence of that give-and-take interchange which his hypothesis postulates; and the whole internal evidence in his papers is in accord with that view.

"Then as to the claim that Alternating Mimicry is practically the same thing as Reciprocal Mimicry. This is a statement which I am entirely unable to accept. Throughout Dr. Dixey's writings I can find no trace whatever of the conception of Alternating Mimicry as I have defined it above. It has been seen that this conception is based entirely on the view that the relative number of individuals is the most important factor in determining the direction of the mimetic approach between any two species of equal inedibility. Yet lxxiii]

this question of relative numbers has been entirely neglected by Dr. Dixey in dealing with his supposed cases of mimetic interchange. How can he explain this strange omission if Alternating Mimicry was really an essential portion of his hypothesis as he suggests? It is difficult also to understand how he could have made the following assertion: 'It seems hitherto to have been taken for granted that a dominant form will attract or retain other species within its own sphere of influence, without being itself attracted in return; whereas the fact is, as we have seen, that each member of an inedible association has more or less influence upon all the rest' (*op. cit.* 1897, p. 327). Now I do not at all accept the validity of this theoretical 'fact,' and it is quite at variance with the principle which underlies the suggestion of Alternating Mimicry. One final quotation will suffice. We have been told that 'the most complete intermingling of characters given and taken on both sides may be expected when two species meet on equal terms, neither being strong enough to predominate over the other' (*l. c.*). This then is considered to be the *optimum* condition for the production of Reciprocal Mimicry, and it is obvious that any possibility of Alternating Mimicry is entirely excluded; indeed, from the standpoint of that hypothesis there would be no mimicry at all in such a

case, because the species would be in what I have called a state of mimetic equilibrium. It is also obvious that if mimetic approach be possible between two such species, then it must necessarily be simultaneous. I therefore feel entitled to claim that I was fully justified in asserting simultaneous approach to be an essential feature of the hypothesis of Reciprocal Mimicry, and that I was also justified in treating Alternating Mimicry as a conception differing radically from it."

Wednesday, November 4th, 1908.

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STICK INSECT.—Mr. R. SHELFORD showed a "Stick" insect—apparently a new species of the genus *Menexenus*—bred parthenogenetically by Mr. H. MAIN.

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THE DOUBLE OR COMBINED APOSEME.—Dr. F. A. DIXEY exhibited specimens of *Heliconius amphitrite*, Riff., and *H. charithonia*, Linn.; also a coloured drawing of *H. hermathena*, Hew. He remarked that each of the first two species showed a distinct and well-marked aposeme or warning character; each of them, and especially the first, belonging to an extensive mimetic assemblage. In the third species these two distinct aposemes were combined.

These specimens illustrated the fact that a conspicuous and distasteful form might acquire a new aposeme without relinquishing its old one, such an intermediate form presumably sharing in the protection afforded by the aposematic forms on each side of it, while the separate aposemes which it exhibited were not mutually protective. This would give the intermediate form an advantage over the extremes, provided that all were found in the same district, or (which was not quite the same thing) were exposed to the attacks of the same enemies. In this particular case the facts of geographical distribution made such a protective relation between the forms unlikely; but the series afforded a good illustration of the actual existence of what he had before spoken of as the "double" or "combined" aposeme.

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Professor E. B. POULTON, F.R.S., exhibited the male and female imago, the preserved larva and the cocoon of an interesting new Lasiocampid moth discovered near Durban by Mr. E. L. Clark, F.E.S., who had sent the following note:—

“In December last year I found what I at once recognised as a rare caterpillar, while engaged on some work at Bellair, a suburb of this town. There was a considerable quantity of them, and I took over a score altogether. I distributed some of the larvæ to other collectors, and at the same time preserved several. From the remainder I bred in the course of last March, 8 ♀ and 1 ♂. The male was in very poor condition, as it started to flutter its wings and wore the edges into shreds before I knew that it had emerged. In fact, it was the drumming of its wings that called my attention to it, the noise being like a continual hum. No one here recognised the moth, nor did Sir George F. Hampson to whom I sent larvæ, pupæ and imago. I then sent a specimen of each to Prof. Chris. Aurivillius, who kindly described it as *Glocia clarki*. I am happy to say that my few remaining pupæ are now emerging. Last week I bred 1 ♂ and 1 ♀. This time by good luck I saw the ♂ before he started to exercise his wings, and he is perfect. The fact that two broods have emerged from a single batch of cocoons is interesting. The larvæ taken last December were evidently the outcome of the late 1907 brood, as most of the *Lasiocampidæ* known to me are very slow feeders. The tree they feed on (*Dichrostachys nutans*, Bth.) seems very scarce round Durban, and I do not yet know of one nearer than Bellair.”

Professor POULTON then read the following letter from Mr. S. A. Neave, F.E.S., describing the habits of a mimetic species of *Euphædra*:—

Nr. Kasama, N.E. Rhodesia, May 13, 1908

“I am now back again on the High Plateau, and find the Fauna very interesting, on the whole similar to that of the higher ground in Katanga. *Mimacræa marshalli* and *Pseudacræa poggei* both occur, but are rare. Perhaps I am a bit late. One thing here which affects the fauna is the scarcity of virgin forest. The natives here have been accustomed for generations to destroy huge areas for cultivating their gardens.

This is all stopped now by the Administration, but it will take the country a long time to recover.

"I have not taken very much of Bionomic interest lately, except 5 or 6 specimens of a sp. of *Euphædra*, probably *E. eusemoides*, Grose-Smith and Kirby—the one with a yellowish bar across the fore-wing and a magenta black-bordered hind-wing, which mimics a gaily coloured diurnal Agaristid moth of the genus *Eusemia*. I did not take the moth, which is common everywhere at the beginning and during the middle of the rains, because I think I was too late for it. I have noticed before that individuals of the genus *Euphædra* seem to be very long-lived and live on until their wings are mere shreds. When I was on the Lufupa River last October at the end of the dry season there were a number of much-worn individuals haunting the shady dry river beds, evidently survivors from the previous wet season. The interesting thing about the above species of *Euphædra* is that it differs in its *habits* from its allies. It spends little or none of its time on the ground as they nearly all do, but is constantly flying around trees and large shrubs,—*the very thing its model is fond of doing*. One or two of my specimens were caught by sending small boys up trees after them.

"I have taken at least two species of *Hesperidæ* with well-marked Acraëine under surface."

Professor E. B. POULTON also exhibited a set of 23 butterflies captured on a patch of Zinnia in the course of half-an-hour, Feb. 21, 1906, at Jinja (3775 ft.), on the N. of the Victoria Nyanza, by Mr. C. A. Wiggins, F.E.S. Seventeen specimens were *Danaiida chrysippus*, L., of the type and *alcippus* forms, together with intermediate examples. Not a single specimen of *dorippus (klugii)* was present, although of three females of *Hypolimnna misippus*, L., two were of the *inaria*, Cr., form, mimicking *dorippus*. Similarly of two *Acraea encedon*, L., one was the form *daira*, Godm. and Salv., resembling the same model. The twenty-third specimen was a female of *Acraea terpsichore rougeti*, Guér., a very poor and perhaps incipient mimic of the type form of *chrysippus*. Professor POULTON pointed out that at Gondokoro to the N., Entebbe to

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the S.W., and everywhere eastward from the N.E. shores of the Lake to the coast, the *dorippus* form was more abundant than the type form, and that in all his experience he had never received from any of these localities such a group as that now exhibited.

lxxxvi] Wednesday, November 18th, 1908.

IDENTITY OF CHARAXES.—DR. KARL JORDAN exhibited examples of *Charaxes zoolina*, and its nearest allies, *C. betsimisarakana* and *betanimena* from Madagascar, *zoolina* and *neanthes* lxxxvii]

from East Africa, *phanera* and *ehmkei* from West Africa, *kahldenii* and *homeyeri* from West Africa. This exhibit confirmed the result of Mr. G. F. Leigh's breeding experiment mentioned by Professor E. B. Poulton at the last meeting. xci]

MIMETIC RELATION BETWEEN COLAENIS TELESIPHE, Hew., HELICONIUS TELESIPHE, Doubl., and PEREUTE ANTODYCA, Boisd.—DR. F. A. DIXEY exhibited specimens of the genera *Colaenis*, *Heliconius* and *Pereute*, remarking upon them as follows:—

"In his recently-published 'Essays on Evolution,' Prof. Poulton has drawn attention to the close resemblance between the Nymphaline *Colaenis telesiphe*, Hew., and the Heliconine *H. telesiphe*, Doubl. He notes (*l. c.*, p. 334) that the *Colaenis* has departed widely from the usual aspect of its genus, while the *Heliconius* is not far removed in appearance from many of its nearest allies. On these grounds, which are well illustrated by the specimens of both genera here exhibited, we must, as he says, consider *C. telesiphe* the mimic and *H. telesiphe* the model. But, as Prof. Poulton further remarks, there is evidence that the *Colaenis* is the commoner insect of the two; and this circumstance, reinforced by F. Müller's observation of stink-glands in *Colaenis*, favours the Müllerian interpretation of the relation between these insects.

"Accepting Prof. Poulton's view of the case, which indeed it would be very difficult with our present knowledge to controvert, I wish to draw attention to another fact, which also can easily be verified by reference to the present specimens. This is that whereas the upper and under surfaces of the

Heliconius are much alike and both aposematic, the under side of the *Colaenis* differs from its upper surface in being strongly cryptic, especially in the normal position of rest. If then the relation between these two forms is really Müllerian, we have here an instance of a distasteful butterfly cryptically coloured beneath; an instance in some respects comparable with the well-known cases of *Protopogonius*, *Elymnias* and *Eronia leda*. These forms are nearly all mimetic above and cryptic beneath; and while there exists more or less reason for considering them to be at any rate relatively distasteful (see Poulton, *l. c.*, pp. 350–354), the evidence of unpalatability in the present instance is perhaps stronger still.

“A further point of interest is the resemblance between the under side of *H. telesiphe* and that of the Pierine *Pereute antodyca*, Boisd. ♂. There can be little doubt that the under

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side of the latter butterfly, so unlike that of the ordinary Pierine, is mimetic in character. But if we attempt to assign it a place in the *telesiphe* combination, we are met by the fact that whereas *C.* and *H. telesiphe* inhabit Ecuador, Peru and Bolivia, *P. antodyca* is only known from Southern Brazil. It may of course be the case that the range of one or more of these species is wider than we are at present aware of; it is also conceivable that they may be linked together geographically by forms as yet unknown to science. But in the absence of any definite information on these points, we must be content to leave it as a puzzle that while the *Pereute* bears only a rough resemblance to Heliconine forms such as *H. besekei*, Ménétr., and *H. erato phyllis*, Fabr., which inhabit the same part of the South American continent with itself, it is strikingly similar in aspect to a *Heliconius* which is separated from it in geographical position.

“A final matter of interest is the appearance on the under side of the hind-wing of *H. telesiphe* of dark nervular and internervular streaks radiating from the base of the wing towards its periphery. This is an aposeme of very widespread occurrence among Neotropical butterflies, being found in Nymphalines, Heliconines, Acraeines and Erycinids, besides other groups. In *Pereute antodyca* it is present, though not to a very marked extent; in many other Pierines it is present

and strongly mimetic. It is well seen in *Heliconius hortense*, Guér., here exhibited, but is absent from the cryptic under surface of *Colaenis telesiphe*."

Wednesday, December 2nd, 1908.

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HABITS OF LIMENITIS.—Professor E. B. POULTON, F.R.S., read a note on the drinking habits of *Limenitis sybilla*, communicated by Mr. Keynes of Pembroke College, Cambridge. A discussion followed in which Mr. H. ROWLAND-BROWN, the Rev. G. WHEELER and other Fellows joined, suggesting from observations made in the forest of Eclépens, Switzerland, and elsewhere, that there is nothing unusual in the settling habit of this species in warm moist woodland places to drink.

MIMICRY BY COLAENIS TELESIPHE AND BELENOIS THYSA, PROBABLY MÜLLERIAN.—Dr. F. A. DIXEY exhibited specimens of *Colaenis*, *Heliconius*, *Pereute*, *Mylothris* and *Belenois*, and remarked on them as follows:—

"It will probably be some time before a complete agreement is reached as to the delimitation of frontier between Batesian and Müllerian mimicry. One character that has been suggested as a criterion is the possession of cryptic colouring on the under surface. It has been argued, as by Mr. Shelford, that no insect is likely to be both aposematically and cryptically coloured at the same time; and that therefore any mimic, such as *Protopogonius*, whose under side is adapted for concealment, must be of the Batesian and not of the Müllerian description. I have myself always been doubtful as to the value of this criterion, and I have reason to know that my doubts are shared by Prof. Poulton.

"It will be remembered that at the last meeting I showed that *Colaenis telesiphe*, Hew., though undoubtedly a mimic of *Heliconius telesiphe*, Doubl., was cryptically coloured beneath. But the available facts as to the relative frequency of the two species, as stated by Prof. Poulton, make it difficult to apply Batesian principles to the interpretation of the present case. Since that meeting, Mr. W. F. H. Rosenberg has kindly furnished me with some additional details as to the

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occurrence of the two species, which tend to strengthen

the conclusion that the *Colaenis*, so far from being relatively rare, as we should expect of a Batesian mimic, is probably commoner than the *Heliconius*. Collections received by Mr. Rosenberg from three different localities contained altogether 76 of the *Colaenis* and 73 of the *Heliconius*. The numbers were distributed as follows :—

	El Porvenir.	Pozuzo.	Huanca- bamba.
<i>Colaenis</i>	12	32	32
<i>Heliconius</i>	56	—	17

There was no reason, so far as Mr. Rosenberg is aware, for the collectors to have given more attention to one species than to the other.

“There appears to be no doubt that the *Colaenis* is the commoner insect in dealers’ stocks. Mr. Rosenberg has also sent me some figures which show that one dealer charges nearly three times as much for the *Heliconius* as for the *Colaenis*; another charges twice as much; and a third has a stock of the *Colaenis*, but does not list the *Heliconius* at all.

“It is hardly to be expected that a Batesian mimic should be as common as, and even less to be expected that it should be commoner than, its model; still more improbable does it seem that the Batesian mimic should occur in places from which its model is absent. This is one reason why I am inclined to think that the mimicry of *Mylothris agathina*, Cram., by the dry-season form of *Belenois thysa*, Hopff., is Müllerian rather than Batesian. In a morning’s collection at Congella, near Durban, Natal, in 1905, Dr. Longstaff and I found *B. thysa* not uncommon; but *M. agathina* was not to be seen, though we were on the look-out for it for purposes of scent-extraction. This observation is confirmed by a record in the *Entomologist*, vol. xli, 1908, p. 31, where Mr. H. W. Simmonds says that at Stella Bush, Berea, Durban, on March 5, 1907, ‘one of the commonest butterflies was *Pieris* [*Belenois*] *thysa*, but, strange to say, its model, *Mylothris agathina*, was quite scarce.’ *Mylothris agathina* is no doubt generally the commoner form, but there are evidently times and places when it has to yield in point of frequency to its mimic *Belenois thysa*.”

EXTRACTS FROM THE PROCEEDINGS
OF THE
ENTOMOLOGICAL SOCIETY OF LONDON
(MARCH 3RD—DECEMBER 1ST, 1909).

Wednesday, March 3rd, 1909.

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MENDELISIM IN *ACIDALIA VIRGULARIA*, HB.—MR. L. B. PROUT, on behalf of himself and Mr. A. BACOT, brought for exhibition a very extensive series of *Acidalia virgularia*, Hb., bred in ten successive generations from various crossings of the London and Hyères race, which had been undertaken with a view to the further study of Mendelism. The results showed non-Mendelian inheritance, there being no segregation with pure and hybrid forms in definite proportions; and thus supported Mr. BACOT's opinion that such were only to be expected in cases of hybridization of forms in which Natural Selection had virtually eliminated intermediates, or in other words, that apparent Mendelian phenomena were manifestations of selective purity, rather than of gametic purity.

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A discussion followed in which Mr. BACOT, Dr. T. A. CHAPMAN, Mr. G. MEADE-WALDO and the PRESIDENT took part, Mr. A. HARRISON pointing out that in similar experiments conducted by himself with Mr. H. MAIN with British *Pieris napi* × *P. var. bryoniae* from Switzerland carried through three generations, they had quite failed to obtain Mendelian proportions, but in the case of *Aplecta nebulosa* the Mendelian proportions were absolute. (Cp. Proc. Ent. Soc. 1907, p. liv.)

Papers.

Mr. G. A. K. MARSHALL, F.Z.S., read a paper entitled "Birds as a Factor in the production of Mimetic Resemblances in Butterflies." He explained that one of the chief criticisms

directed against the theories of mimicry was to the effect that, on the whole, birds did not destroy butterflies to any appreciable extent ; he had therefore collected together all the available evidence bearing on the question. As indicating the extent of such observations, it was stated that these records refer to a considerable number of species of both birds and butterflies, as might be judged from these approximate figures : Palaearctic Region : 33 birds, 34 butterflies ; Ethiopian : 26 birds, 26 butterflies ; Oriental : 27 birds, 46 butterflies ; Nearctic : 46 birds, 20 butterflies. Unfortunately in the Neotropical Region, from which the greatest amount of evidence might have been expected, such exact observations had been almost [viii

entirely neglected. It was contended that the negative evidence on this subject, which appeared to have been very generally accepted, was really of very little scientific value, because in no case had it been shown that the observer had any adequate knowledge of the actual food-habits of birds, or that any careful and exhaustive inquiry had been made into the subject. Instances were also cited to show how very easily destruction of this kind might be overlooked ; while negative evidence derived from an examination of the contents of birds might be very misleading, owing to the fact that in so many instances the butterflies' wings are not swallowed, so that any recognition of the remains becomes extremely difficult. Finally, it was urged that the large body of evidence resulting from merely casual observations indicated that the assumption that birds do not eat butterflies to any extent is certainly premature, and that a fuller inquiry will probably show it to be entirely unfounded.

A discussion followed in which Mr. A. W. BACOT, Mr. H. ROWLAND-BROWN, Mr. H. MAIN, Mr. A. E. TONGE, Mr. H. M. EDELSTEN, Mr. J. W. TUTT and other Fellows, gave their experiences on the subject, Mr. W. SHARP suggesting that the actions of the sparrow, as a domesticated bird, was not evidence for conditions which exist in the case of purely natural species. Dr. T. A. CHAPMAN suggested that the paucity of observations on the point was largely due to the shyness of birds eating in the presence of human beings. Mr. W. J. KAYE said that he had never observed birds attacking butter-

flies in tropical South America, and Commander J. J. WALKER gave similar testimony with regard to the many Australasian and other oversea localities visited by him.

Wednesday, April 7th, 1909.

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Mr. R. SHELFORD exhibited a case containing a number of examples of mimetic Oriental *Blattidae*, the models being Coleoptera, principally *Coccinellidae* and *Chrysomelidae*.

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Papers.

Mr. G. A. K. MARSHALL read a paper entitled "On Reciprocal Mimicry." A Rejoinder to Dr. F. A. Dixey." In the course of his remarks the author explained that the main difference between his views and those of Dr. Dixey as to the development of Müllerian resemblances might be stated as follows. The latter gentleman considers that within the limits of a Müllerian association every species exercises a mimetic influence upon every other, the amount of the influence depending upon its dominance, which is determined by its numbers, distastefulness and general notoriety. Thus, as between any two species, the mimetic approach would be mutual and result in an interchange of characters. This interchange would be proportionate to the relative dominance of the two species; where this is unequal, the weaker species would take on, to a considerable extent, the superficial appearance of the stronger, while the latter would adopt only some small characters from its mimic; but where the dominance is equal, the interchange would be equal, so that this would constitute the optimum condition for the production of Reciprocal Mimicry.

On the other hand, Mr. MARSHALL contended that this gravitational conception of mimicry was really based on a false analogy and was at variance with the real principle of Müller's theory. While admitting the theoretical possibility of mimetic interchange, he urged that a logical application of Müller's argument would lead to the view that mimetic approach would be one-sided only, that is, from a weaker

species towards a stronger and never in an opposite direction ; further, that when the relative dominance of the two species

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was equal the mere operation of Müller's factor would produce no mimetic effect, until some other factor had first produced a condition of inequality. On this view mimetic interchange would never be mutual and simultaneous, but would only result from a complete reversal of the relative dominance of the two species during the production of the mimetic resemblance. For this process he had suggested the name of "Alternate Mimicry." The author was also compelled to reject entirely Dr. Dixey's new hypothesis as to the "function of the double aposeme," because it completely left out of consideration the differences and resemblances between the various forms regarded from the standpoint of general facies ; he contended that resemblance in general effect was of the first importance in considering mimetic relationship, and that this new hypothesis was liable to be extremely misleading on account of the exaggerated significance which it attached to the merely partial resemblance which might be said to exist between two species possessing a single conspicuous feature in common but differing markedly in other respects. Moreover, not only was the theoretical position of Reciprocal Mimicry very unsatisfactory and unconvincing, but further, the cases which had been cited as proving its actual occurrence in nature appeared open to serious criticism. For while in some cases the facts did not appear to justify the assertion that an interchange had taken place, in the others such an interpretation involved many difficulties which disappeared when the mimetic phenomena were interpreted as being due to the simple mimicry of one form by another.

In illustration of his contentions Mr. MARSHALL exhibited a number of butterflies, the great majority of which had been kindly lent for the purpose by Mr. W. J. KAYE, the remainder having been kindly supplied by Dr. K. JORDAN and Mr. HAMILTON DRUCE.

Dr. DIXEY then stated that he did not consider the Presidential Chair to be a proper place in which to reply to Mr. Marshall's criticism, and that he would therefore deal with the points at issue on some future occasion. Mr. C. J.

GAHAN very strongly supported the opinions advocated by Mr. Marshall, and expressed the view that while Dr. Dixey xxii]

professed to support Müllerian mimicry, yet his defence of Reciprocal Mimicry really constituted a severe attack upon that theory. For he pointed out that Dr. Dixey had condemned certain of Mr. Marshall's contentions as vitiated and valueless because they were based on inaccurate postulates, whereas these postulates were the very ones which Fritz Müller himself had used.

Mr. S. A. NEAVE said that as a result of his field experience in Africa he was unable to accept the theory as to the function of "double aposemes," but he did not mean thereby to imply that he rejected every case of Reciprocal Mimicry. He suggested that Alternate Mimicry might not be so uncommon a phenomenon as Mr. Marshall appeared to think.

Mr. J. W. TUTT asked whether Mr. Marshall really knew of a single instance in which two species, supposed to carry different aposemes, lived in the same place with another species that showed the double aposeme of these species, and occurred with them at the same time. He remarked further that in his exhibit Mr. Marshall showed two species with different aposemes living in Peru, together with the presumed species showing the double aposeme, which he noted did "not occur within 1000 miles of Peru"; was there no instance known in nature which illustrated the point at issue, and so removed the question from the rank of pure theory?

Mr. MARSHALL said that such a case was not known to him.

Mr. W. E. SHARP and Professor T. HUDSON BEARE also made some brief comments on the subject.

Wednesday, May 5th, 1909.

RHINOCEROS OESTRID FLY.—Mr. S. A. NEAVE exhibited three specimens of a remarkable Oestrid fly belonging to the genus *Spathicera*, Corti, captured on the carcass of a rhinoceros shot by him near Fort Jameson, N.E. Rhodesia, in February xxiii]

1908. He pointed out the extreme rarity of individuals of

this genus in the imago state, though Oestrid larvae had long been known and frequently recorded in the intestinal canal of *Rhinoceros bicornis*, and recently Professor Sjöstedt had succeeded in rearing one individual from a larva, described by him under the name *meruensis*.* The only other known specimen from Africa seemed to be that reported from Gallaland by Brauer under the name *pavesii*.

Mr. NEAVE remarked that this seemed to be the first recorded occasion on which the adult insect had actually been observed to be following the rhinoceros, and it was of some interest in this connection that both sexes were represented (2 ♂♂, 1 ♀). The resemblance of these insects to Hymenoptera of the genus *Salix*, an individual of which, *Salix* n. sp. near *imperialis*, Sm., he exhibited for comparison, was so marked that, having no net with him, he had hesitated to catch the flies by hand, though this was easy to do owing to their sluggish flight and reluctance to leave the carcass. In conclusion Mr. NEAVE put forward the suggestion that the presence of these parasites may be an explanation of the peculiar and well-known habit of the rhinoceros in invariably scattering his dung with his horn. It seemed not improbable that the animal did this in an instinctive attempt to kill the larvae by exposing them to the sun's rays.

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DANAIDA CHRYSIPPUS, Linn.—Dr. G. B. LONGSTAFF exhibited a series of 33 specimens of *Danaida chrysippus* taken by him in Egypt and the Sudân during January and February 1909. Two taken at Cairo, one at Kom Ombo and one at Aswân, were all typical, but somewhat dark. A few other specimens were seen at each of these localities, but none of them had white hind-wings. At Khartûm, where the butterfly was fairly common, 25 specimens were taken: of these two might be described as typical, though lighter than the Egyptian specimens; in eight the veins near the middle of the hind-wings were dusted with white scales; in seven the centre of the hind-wings was more or less white, as in Moore's *alcippoides*; while seven might be described as typical *alcippus*, Cram. One

* Wissenschaftliche ergebnisse der schwedischen zoologischen expedition nach dem Kilimandjaro, dem Meru. Diptera. Oestridae, Pl. I, fig. 1, 2, 1908.

specimen only was seen of the form *dorippus*, Klug, and this had the hind-wings almost entirely white—f. *albinus*, Lanz. So far as could be estimated in the field, three-fourths of all the specimens seen at Khartûm were either *alcippus* or *alcip-*xxvi]

poides. On the White Nile between El Duêm and Gebel En (lat. $14-12\frac{1}{2}^{\circ}$ N.) four specimens were taken, three typical or nearly so, one of the *alcippus* form. These figures are in marked contrast to the proportions found by the President* among Mr. Loat's captures on the White Nile in lat. $11-4\frac{3}{4}^{\circ}$ N. In that case out of the same total (33), no less than twelve were referred to "*dorippus*" (2), or "*ilugii*" (10). Dr. Longstaff called attention to the fact that whereas the transition from the type to *alcippus*, or from *dorippus*, Klug, to *albinus*, Lanz., is quite gradual; on the contrary, that from the type to *dorippus* appears to be abrupt.

xxxii] Wednesday, June 2nd, 1909.

A MIGRATION OF LADYBIRDS.—Dr. G. B. LONGSTAFF exhibited a number of specimens of *Coccinella 11-punctata*, L., from the White Nile. On February 16th, 1909, when about 40 m. above Khartûm, numerous lady-birds settled upon the steamer—there were probably many hundreds; they all flew from the East against a slight westerly breeze; the flight lasted from 4.50 p.m. till nearly 6 p.m.; all those taken (25) proved to be xxxiii]

Coccinella 11-punctata, L., a widely-distributed species, and apparently the common lady-bird of Egypt and the Sudân, as Dr. Longstaff met with it near Cairo, at Aswân, at Khartûm, and 125 miles south of that city at El Duwêm on the White Nile. Swarms of lady-birds in England are alluded to by E. C. Rye ("British Beetles," p. 228); the occurrence of immense swarms of lady-birds on mountains was referred to at a meeting of the Society by Prof. Poulton, quoting Prof. V. L. Kellogg (Proc. Ent. Soc. Lond., 1904, p. 23 *et seq.*). Kirby and Spence (7th Ed., p. 295) mention having personally witnessed *Coccinellæ* alight upon a ship at sea.

Dr. G. B. LONGSTAFF also exhibited a *Scarabæus* taken by him

* Trans. Ent. Soc., Lond. 1903, p. 141.

on the edge of the desert within half-a-mile of the Sphinx. It differed in several structural points from the common *S. sacer*, L., and has since been identified as *S. compressicornis*, Klug, an Arabian species.

CARVED EGYPTIAN SCARAB.—Professor E. B. POULTON, F.R.S., exhibited a scarab beautifully carved out of a hard limestone. The specimen had been obtained by Dr. G. B. Longstaff in Upper Egypt and presented to the Hope Department. Mr. F. Ll. Griffith, the Reader in Egyptology at Oxford, pronounced it to be a good example of the art of about the sixth century B.C.—it might possibly be as late as the third century B.C. Mr. W. Holland and Commander J. J. Walker had not found any beetle so likely to have been copied by the artist, as *Scarabaeus sacer*, L., and Mr. G. J. Arrow, who had examined the specimen, remarked, "The head seems to point to that species undoubtedly, and the striation of the elytra must have been added from the artist's observation of other groups, or from his notions of entomological propriety."

SPECIES OF TWO GENERA OF COCCINELLIDAE CAPTURED IN COITU.—Professor E. B. POULTON exhibited a specimen of *Adalia obliterated*, L., captured *in cop.* with *Halysia 18-guttata*, L., by Mr. Joseph Collins, of the Hope Department. The specimens were beaten out of a fir-tree at Tubney, Berkshire, on August 5th, 1908. They remained paired after being placed in the laurel bottle, and the specimens were seen to be still united.

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DIPTERA FROM OXFORD AND THE NEW FOREST.—Professor E. B. POULTON exhibited the following Diptera, bred or captured by Mr. A. H. Hamm, of the Hope Department. The observations recorded below were from Mr. Hamm's notes.

(1) Ten specimens of *Eccoptomera microps*, Mg., bred from pupae found on February 6th, 1909, in a single mole's nest, on the Headington Wick Farm, near Oxford. They emerged at intervals, the first on March 15th, and the last on April 12th, 1909.

(2) Two specimens of *Miltogramma germari*, Mg., a species new to the British list. They were taken with *M. punctatum*,

Mg., on a sandy path, near Shotover Hill, Oxford, on August 7th, 1907. The path is very much frequented by various species of Aculeate Hymenoptera, about the burrows of which they were captured. (*Vide* E. M. M., 1909, p. 105.)

(3) A specimen of *M. punctatum*, Mg., was one of several observed following the bee, *Colletes succincta*, L. The fly exhibited was captured as it was following a male of the bee along a sandy bank, near Lyndhurst, on August 2nd, 1907, both it and the bee being taken in a single sweep of the net. Mr. Hamm and his friend, Mr. G. Arnold, watched them frequently following the *Colletes*, but not so persistently, as in the case of *Chortophila unilineata*, Ztt., recorded in Proc. Ent. Soc. Lond., February 7th, 1906.

(4) A specimen of *Sphecapata conica*, Fln., was one of two which very persistently followed the Fossor, *Crabro scutellaris*, Sm., ♀. All three were netted together, but one of the flies escaped while endeavouring to box them. The observations were made and the specimens captured near Denny Bog, in the New Forest, August 14th, 1908.

A RARE CASTNIA BRED FROM AN ORCHID IN ENGLAND.—Professor POULTON exhibited an example of the rare Castniid moth, *Castnia therapon*, Kollar, captured on December 26th, 1908, flying in his orchid-house at Broadstone, Dorset, by Dr. A. R. Wallace. The empty pupa-case, also exhibited, was found among the roots of a *Stanhopea*, which had been more than a year in Dr. Wallace's possession. Its previous history was set forth in the following statement received by xxxv]

him from Mr. Hall, of Buenos Ayres: "The *Stanhopea* I sent you had been in my conservatories for some years. It originally came from Santos, Brazil (Province of São Paulo)." Dr. Wallace had written to Professor E. B. Poulton concerning this very interesting observation: "As Mr. Hall's conservatories are in the suburbs of Buenos Ayres, the *Castnia* is hardly likely to have inhabited that treeless region. Southwest of Santos there appears to be an almost uninhabited tract of hilly country between the Sierra and the sea, and therefore probably forest-clad and more likely to produce both the orchid and the moth. I should not wonder if the coast forests of São Paulo were very rich and perhaps not much known, as

every traveller wants to get into the 'interior,' and away from the coast. Of course, 'some years' may mean 'more than one,' and the plant having been gathered when dry and dormant the insect may have been delayed in emerging."

EURYTELA HIARBAS, DRURY (1782), A PROBABLE FORM OF *E. DRYOPE*, CRAMER (1775).—Professor POULTON said that he had received a letter from Mr. G. F. Leigh, F.E.S. of Durban, containing the following interesting observation: "I have to record that on two occasions within a week, viz. on the 3rd and 7th of April [1909], I saw *Eurytela dryope*, in cop. with *E. hiarbas*, and only once in cop. with its own form. I am going to breed from a ♀ of *E. hiarbas*, and perhaps I shall prove that it and *E. dryope* are forms of the same species, as indeed I quite expect them to be."

Professor POULTON said he had asked Mr. Marshall his opinion as to the specific identity of these two forms and had received the following reply: "I have long had suspicions as to these two forms; for not only did Bowker take them paired long ago, but he also caught what appears to be an intermediate form, described by Trimen, and named *hiarbas* var. *flavescens* by Aurivillius. On the other hand, if they are species it is rather singular that their ranges are not coincident. For instance, *hiarbas* is common in the forest regions of Eastern Cape Colony and even ranges as far west as Knysna, while *dryope* is not yet known from south of Natal. Again a form of *dryope* occurs in Madagascar, but no *hiarbas*, and so forth. Then *hiarbas* varies geographically in the width of the [xxxvi

h.w. band, but there does not seem to be a corresponding variation in *dryope*, as one might expect. They both vary in the angulation of the f.w., but the range of the forms is not quite coincident, for apparently in Angola and the Congo region the southern form of *dryope* occurs in conjunction with the western form of *hiarbas*. These are not insuperable difficulties in the way of considering the two forms as conspecific, but they emphasise the necessity for proof by breeding before any such view can be properly accepted. I sincerely hope that Leigh will be able to carry out the experiment he suggests."

A little later Mr. Marshall again wrote on the same subject:

"I was looking at the *Eurytelae* in the British Museum the day before I left, and I was interested to notice that the southern form of *dryope* differs notably from *hiarbas* in the disposition of the markings below the cell on under-side of f.w. But in one of the western forms (*alinda*, I think it is,) these markings are identical with those of the western *hiarbas*, and the h.w. band is also very similar in width and position; so that this possibly represents the more primitive form of *dryope*."

HEREDITY IN THE FEMALE FORMS OF *HYPOLIMNAS MISIPPUS*.
—Professor POULTON showed a series of forty-nine females and seven males (being all that had been kept of this sex) of *Hypolimnas misippus*, bred by Rev. K. St. Aubyn Rogers, M.A., F.E.S., from a female captured October 31st, 1908, at Rabai, near Mombasa, British East Africa, where the *inaria* form of female is no commoner than the type form. The female parent was intermediate between the type and the *inaria* form, but on the whole nearer the former: it bore a very faint white patch on each hind-wing, thus slightly tending towards the var. *alcippoides*. It was a very remarkable fact that the whole of the female offspring were *inaria*,—not a single type form, not a single intermediate. On the other hand, twenty-one specimens possessed to a variable extent, and on the whole very slightly, the *alcippoides* characteristic of a white patch on the hind-wing. The dates of emergence of the females (including a crippled *inaria* emerging Nov. 27th and not retained) and the whole of the males were as follows, the letter *a* indicating *alcippoides*:—

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1908.	Females.	Males.
Nov. 27	8 (3 <i>a</i> .)	21
„ 28	28 (12 <i>a</i> .)	18
„ 29	9 (4 <i>a</i> .)	1
„ 30	5 (2 <i>a</i> .)	—
Totals	50	40

Professor POULTON said that this remarkable experiment perhaps tended to support Col. Manders' suggestion that the species could be influenced in the direction of the *inaria* form

by dry conditions; but large experiments specially designed to test this hypothesis were required before it could be accepted. The distribution of the *inaria* form in Africa did not seem to point in this direction. We did not yet know the conditions of moisture or dryness under which these larvae and pupae had been kept by Mr. Rogers. Whatever the interpretation,* the results were extremely interesting, and contrasted in a remarkable manner with those obtained by Mr. G. F. Leigh, F.E.S. (Trans. Ent. Soc. Lond., 1904, pp. 689, 690, Plate XXXII). The relative number of the females and the slightly earlier average emergence of the males were interesting points shown in the above table.

MÜLLERIAN MIMICRY IN EUPLOEINAE.—Professor POULTON exhibited sets of Euploeine butterflies from Southern India, the Solomon Islands, New Guinea, and Fiji, showing that the pattern, which differed at each of these localities, was followed by various local species. Two different patterns were shown from New Guinea and two from the Solomons. The exhibition was intended to meet the criticisms contained in a letter by Lt.-Col. Manders, read at a recent meeting and now published in the "Entomologist's Record" for May (pp. 120, 121). The writer of this letter implied that the resemblances figured by

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Mr. J. C. Moulton on Plate XXXIV of the 1908 Transactions were precisely parallel to those of the commoner British species of *Pierinae*. The specimens exhibited, to which many others might have been added, proved that the argument was unsound. The patterns of *Pierinae* did not exhibit anything like the same local peculiarities and local resemblances as those of the *Euploeinae*. Col. Manders had also implied that the Müllerian interpretation of the resemblances between Euploea was a recent innovation, whereas it had been suggested by Prof. Meldola, F.R.S., in 1882 ("Ann. Mag. Nat. Hist.," 5th Ser., Vol. X, 1882, p. 417), and set forth in detail by the late Frederick Moore in the following year ("Proc. Zool. Soc.,

* Mr. L. Doncaster, F.E.S., who examined the series at the conclusion of the meeting, suggested that the results may be due to the Mendelian dominance of the *inaria* over the type form of female, the tendency to *inaria* having been carried by the male parent. It would be of the highest interest to test this suggestion by breeding from the first filial generation (F. 1).—E. B. P., June 20th, 1909.

Lond.," 1883, p. 201). There was evidence that Euploeas were distasteful, and resemblances independent of affinity between distasteful species had been reasonably interpreted by the Müllerian hypothesis. The interpretation in this case, although offered nearly thirty years ago, had not, so far as the speaker was aware, been called in question before. In the absence of Mr. Moulton in Borneo, Professor Poulton wished to say these few words in defence of his communication published in the Transactions of last year (p. 585).

As bearing on the same subject, Professor Poulton showed a male example of the Euploeine butterfly, *Tronga crameri*, Lucas, sent to him by Mr. J. C. Moulton, F.E.S., together with a large Lycosid spider which was said to have captured it. The specimens had been brought to Mr. Moulton by one of his collectors who stated that he saw the butterfly in the grasp of the spider. They were found (April 21st, 1909) on a post near Kuching, Sarawak. The observation threw light on the enemies of specially defended groups of insects.

SMALL MOTHS CAPTURED AT SEA PROBABLY 190 MILES FROM THE LAND THEY HAD LEFT.—Professor POULTON exhibited moths observed at sea and sent to him by Mr. F. Muir, F.E.S., and Mr. J. C. Kershaw, F.E.S. Mr. Muir in a letter written on his way from Hongkong to Ceram, and dated December 24th, 1908, gave the following account of the observation :—

" I enclose some small moths taken at sea on November 29th, 1908, about 107°20' E. and 6° N., that is, about 190 miles S.S.E. of the Lower Cochin China coast, and about 120 miles xxxix]

N.N.W. of Great Natunas. The wind was fresh and blowing from off the Cochin China coast: about 10 a.m. we noticed many small moths settled over the deck and all in *perfect* condition, as if just hatched. At first we suspected that they were bred in the ship, but soon discovered that they were coming on board in numbers. For about five hours we noticed these moths in great numbers travelling from about N.N.W. to S.S.E. They had the power of resting on the surface of the sea—even in the broken water around the bows of the boat—and then rising and continuing their journey. There were several other species in small numbers, and among them the delicate little plume moth which I send. I think

these moths must have come from off the Lower Cochin China coast, and, if no bad weather turned up, would reach the various islands, or even Borneo, in fair numbers.

"What surprised us most was the beautiful condition so many of them (or, to be more exact, nearly all) were in, showing that their long journey had had no ill effects upon them."

Professor Poulton said that the species, of which a list is given below, had been kindly named for him by Sir George Hampson, and the "Plume" by Paymaster T. Bainbrigge Fletcher.

Schoenobius bipunctifera, Walk., 7 specimens.

„ *incertulas*, Walk., 7 „

Glyphodes celsalis, Walk., . 1 „

Alucita niveodactyla, Pag., . 1 „

The specimens had unfortunately been attacked by "pests," so that the majority were in bad condition. The small and delicate white "Plume" had escaped this injury and was beautifully preserved.

The species named above possessed the following distribution as shown by the series in the British Museum.

S. bipunctifera :—India, Ceylon, Assam, Burma, China (including places so distant as Omei-shan and Chusan Islands), Formosa, Singapore, Java, Sumatra, Borneo.

S. incertulas :—India, Ceylon, Burma, Singapore, Borneo, Java, Cassini Island (N.W. Australia).

Glyphodes celsalis :—India, Ceylon, Assam, Burma, China [xl
(Central and Western), Japan, Singapore, Borneo, New Guinea, Trobriand Islands.

Mr. T. Bainbrigge Fletcher had informed the speaker that the *Alucita* extended from India to the Philippines and the Solomon Islands, but had as yet been but little observed in the Malay Archipelago.

The wide area over which these species were at present known to range and the absence of any marked local variation might with probability be explained by the power of distribution in the manner detected by Mr. Muir and Mr. Kershaw.

NOTES ON THE LIFE-HISTORY OF AULACODES SIMPLICIALIS,

SNELL.—Professor POULTON exhibited specimens and drawings of *Aulacodes simplicialis*, Snell., one of the *Hydrocampinae*, also sent to him by Mr. Muir and Mr. Kershaw. Mr. Muir's letter of Dec. 24th, 1908, already referred to, contained the following reference to his and Mr. Kershaw's observations:—

“Before leaving Macao we found a little moth living in the streams, and also a parasite that attacks it. I enclose you some sketches (made by Kershaw) of it, along with some notes, and specimens of imago, larva, pupa and cocoon. If the life of this species be unknown the observations may be of interest, and you can use the notes as you wish.”

Accompanying the letter was the following interesting record of the observations conducted by these two naturalists:—

“One of the last entomological excursions we made before we left China was to Lappa, a mountainous island on the western side of the harbour of Macao. Many streams arise among these granite mountains and rush down the steep gullies in a series of small waterfalls. In several spots where the water was most rapid we found the larva of a species of *Hydrocampinae* living on the surface of the rocks, sometimes under eighteen to twenty-four inches of swiftly flowing water, at other times under a few inches, or where the rocks were continuously covered with a shower of spray.

“The larva appeared to be very similar to De Geer's figure of *Paraponyx stratiotata*, L., the second and following ten body segments bearing a protuberance on each side, from which forty to fifty thread-like gills arise (Fig. 1). The pupa is xli]

slightly more thick-set in the thorax than *P. stratiotata* and its proboscis and legs project some way beyond the end of the abdomen. The second, third and fourth abdominal segments bear raised spiracles.

“The larva constructs flat, silken tunnels over the surface of the rocks and fastens little pieces of green alga, upon which it feeds, into the structure. The alga grows and gives the tunnels a cryptic appearance. When full-grown the larva xlii]

constructs a complex cocoon. A stout silken dome is constructed, with a series of holes near the anterior and posterior edges (*b* in Figs. 2, 3, and 4). This is fastened down to the rock

by its posterior and lateral edges, and by the pillars of a series of arches that join the lateral affixed edges, slightly posterior to the front margin (*f* in Figs. 2 and 3). Two, three or four stout pillars also act as strengtheners to hold the dome (*e* in Figs.



FIG. 1.

Dorsal view of larva.

2 and 4). Under this dome is a second cover, formed of finer silk and composed of an upper and lower sheet, with their edges fastened together all round (*c* in Figs. 2, 3 and 4). Within
[xlili
this is a third cover closely attached, and similar to the second

but of still finer texture (Fig. 4, *d*), in which the pupa lies. The water enters under the anterior margin, which is sometimes fastened down at one or two points, and through the anterior holes, and passes out through the posterior holes, the pupa is thus kept dry but well supplied with air. The cocoon

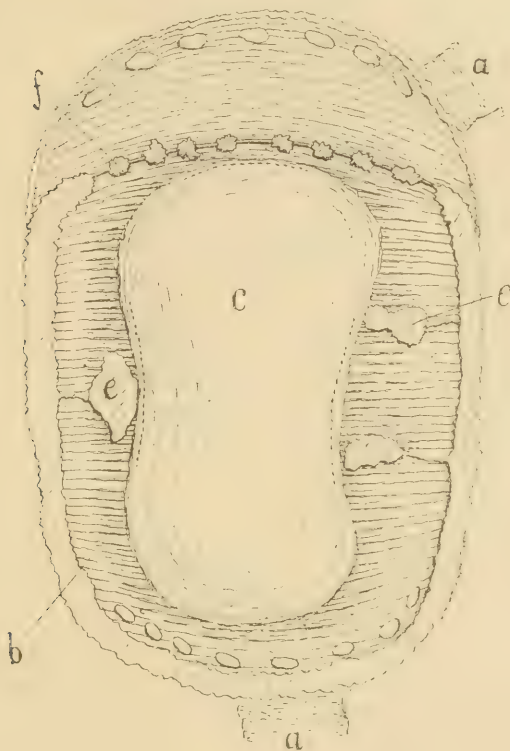


FIG. 2.

Ventral view of Cocoon.

- | | | |
|---------------------|----------|--------------------|
| a. Larval tunnels. | b. Dome. | c. Outer cover |
| e. Pillars of dome. | | Pillars of arches. |

varies in size and shape according to the position in which it is built.

“We took several pupae home and constructed a suitable breeding-cage, in which we hatched out the moth, and also a large Ichneumonid. We had noticed the cocoon and emergence

holes of this parasite at the time when we were collecting the material.

"Copulation took place at night: the male flutters over the female for a few seconds and then they unite very quickly. Two nights later eggs were laid. The eggs are numerous and deposited in rather irregular and straggling batches, but mostly in contact with and adhering to one another. They are obtusely

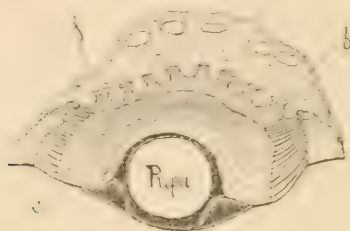


FIG. 3.

Transverse section, showing ventral view of anterior end.
b. Dome. c. Outer cover. f. Pillars of arches.

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oval, smooth, shiny, and of a rather pale orange colour. They were laid on the sides of the breeding-jar just above the water, and on wet blotting-paper, but the female never entered the

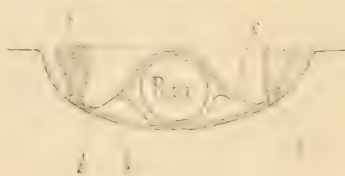


FIG. 4.

Diagrammatic section through centre of cocoon.
b. Dome. c. Outer cover. d. Inner cover. e. Pillars.

water for the purpose of ovipositing, although there were water-plants and algae in the cage. The eggs laid on dry surfaces soon collapsed and dried up, while those on wet surfaces kept in good condition for so long as suitable conditions could be maintained. Unfortunately such conditions could not be maintained on board ship, and all the ova died before we reached Java.

"The adult moth readily takes to the water when frightened, diving below the surface, and using its legs for swimming. The wings are appressed to the body, and the whole insect

more or less covered with air-bubbles. They are capable of remaining thirty minutes or more below the surface, clinging to plants and submerged weeds. It is possible that in suitable situations the females enter the water to oviposit, but this would be impossible where the stream runs swiftest, and in such places it is possible that they lay their eggs on the wet rocks along the edge of the water. We were not fortunate enough to observe the method of oviposition of the parasite."

THE USE OF THE SAW BY A SAWFLY DURING OVIPOSITION.—Professor POULTON said that he had noticed the discussion at a previous meeting upon the "saw" of the female Sawfly, and observed that there was but little direct evidence of its use. He therefore thought it might be of interest to record that about the year 1886 he had watched the female of *Croesus septentrionalis*, L., ovipositing on the under surface of a birch leaf, in his garden at Oxford. Some of the ova then laid were exhibited to the meeting, preserved in spirit. The speaker had been much struck with the deliberate movements of the insect and the facility with which she could be approached and examined with a lens, without any interference with her work. He distinctly remembered the saw being moved backwards and forwards as in the ordinary act of sawing, but could not be sure whether the work was done in the pull (as in certain pruning saws) or the push (as in most saws). The effect was to cut a slit in the leaf tissue beside and obliquely to the axis of the midrib or some chief vein. The saw was

xlvi] then withdrawn and a sausage-shaped egg laid in the slit: another slit was cut parallel with and immediately below the last, and another egg laid. The operation was repeated until a long row of obliquely-placed eggs lay like a seam beside the midrib or vein. He had watched the rapid swelling of the eggs thus laid, probably by absorption from the leaf tissues, and had preserved examples at various stages up to the point at which the larvae hatched. These were exhibited to the meeting.

xliv] Wednesday, October 6th, 1909.

BREEDING EXPERIMENT WITH CHARAXES.—Mr. G. F. LEIGH exhibited the ♀ parent and 21 specimens of the offspring of

Charaxes zoolina neanthes. This result was obtained from ova deposited by the *zoolina* form of the ♀, and produced 4 ♂♂s and 2 ♀♀s like the parent, and ~~15~~ 5 ♂♂s and 9 ♀♀s of the *neanthes* form. Last year the same result was obtained in a smaller degree, but the eggs on that occasion were obtained from the *neanthes* form of the ♀. All the specimens exhibited, the breeding of which was undertaken at the special request of Professor E. B. Poulton, will be placed with those shown last year in the Hope Department, University Museum, Oxford. The proving by breeding from ova that

[1 these two forms are one species has cleared up two or three other similar cases of Butterflies occurring in other parts of the world, that have forms of totally different colour, but are structurally the same. With regard to the examples exhibited Mr. Leigh said that although the *zoolina* form are consistent in both the wet and dry season, there are two quite distinct forms of the *neanthes* variety.

Papers.

Mr. H. ELTRINGHAM, M.A., F.Z.S., read a paper on "Edibility Experiments with Larvae and Lizards."

Wednesday, October 20th, 1909.

Papers.

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Mr. R. SHELFORD, M.A., F.L.S., F.Z.S., communicated a paper "On two Remarkable Forms of Mantid Oothecae."

Wednesday, November 3rd, 1909. [lxiii

Professor E. B. POULTON, F.R.S., exhibited a set of three species of *Planema* (*Acraeinae*), with their Nymphaline and Papilionine mimics, all captured on the same day in a small isolated patch of forest about a mile and a half from Entebbe, by Mr. C. A. Wiggins, a Fellow of the Society. The examples, which were taken on July 11th of the present year, are shown in the following list :—

ACRAEINE MODELS.	NYMPHALINE MIMICS.	PAPILIONINE MIMICS.
<i>Planema poggei</i> , Dew. 2 ♂, 1 ♀.	<i>Pseudacraea hobleyi</i> , Neave. 2 ♂.	<i>Papilio dardanus</i> , ♀ f. <i>planemoides</i> , Trim.
<i>Planema alcinoe</i> , Feld. 1 ♀.	<i>Pseudacraea hobleyi</i> , 1 ♀.	
<i>Planema tellus</i> , Auriv. 2 ♂, 1 ♀.	<i>Pseudacraea terra</i> , Neave.	<i>Papilio dardanus</i> , ♀ f. <i>niobe</i> , Auriv.

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Professor POULTON said that the ample material kindly sent by Mr. Wiggins had now shown beyond any doubt that *Pseudacraea tirikensis*, Neave, was the female of *Ps. hobleyi* of the same author, the two sexes being mimetic of different species of *Planema*. This last point was an interesting one, inasmuch as the sexes of the mimetic *Pseudacraeas* usually mimic the corresponding sexes of the same species of model. Here, however, the female *hobleyi* was a beautiful mimic of the female of *Planema alcinoe*, while the male of *hobleyi* did not mimic the male *alcinoe* but bore the closest superficial resemblance to both sexes of *Planema poggei*.

The speaker expressed the hope that Mr. C. A. Wiggins would persist in his investigation of this deeply interesting locality, and continue his kind and most efficient help to the study of mimicry by forwarding the captures of single days selected at intervals up to the end of next May, thus completing an entire year. It was to be hoped and expected that more light would thus be thrown on the study of mimicry than has ever yet been received from any source whatever.

lxvii] Wednesday, November 17th, 1909.

MIMETIC RELATIONS OF EAST AND WEST AFRICAN BUTTERFLIES.—Mr. H. ELTRINGHAM exhibited examples of certain African butterflies, and explained that when working out the mimetic relations of *Acraea alciope*, Auriv., he had been struck by the fact that whilst in West Africa the female of that species was well known, it having in fact been described from a female, all East African examples were males. He had written to Dr. Jordan to ask him if he had seen any East African females,

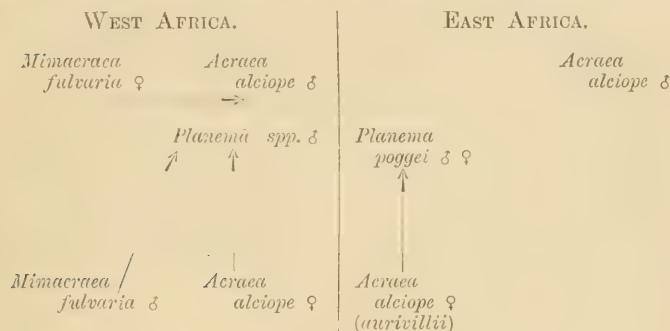
and the latter had replied that in East Africa *alciope* appeared to be represented by the *alicia* of Grose-Smith and Kirby (erroneously described as a *Planema*), that the alleged male (type) of this latter species was in fact a female, and that in all probability the East African female *alciope* would be found to have white hind-wings. Acting on this suggestion he had examined various *Acræas* from the neighbourhood of Entebbe, and found that *Acræa aurivillii*, Staud., common in that region was always female.* He had then visited Tring, where he found that Dr. Jordan had already, some time previously, associated *aurivillii* with *alciope*. It was found that the alleged male *alicia* of Grose-Smith and Kirby was in fact an aberrant female, and that the female which had been described as such was not distinguishable from *aurivillii*. A visit to the National Collection showed that there *aurivillii* had been associated with *alciope* though less definitely, and that Mr. Heron had, with characteristic insight, supplied a note to the effect that the supposed male *alicia* was probably a form of female. The result of the whole investigation was that in *alciope* we had an extremely interesting and complicated case of mimicry. In West Africa the female *alciope* was in an unstable condition, but, generally speaking, mimicked a male *Planema* which was probably a form of *salvini*. At Sierra Leone the pattern of the female was fairly constant, but at Fernando Po intermediate varieties were found, one example he had seen having the fore-wings of the Western type and the hind-wings almost as in *aurivillii*.

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Passing across to Uganda, whilst the male remained the same, the female became established in the form hitherto known as *aurivillii*, and was a very perfect mimic of *Planema poggei*, Dew., one of the commonest species of that genus at Entebbe. It was very remarkable that in *aurivillii* there was a complete development of the brown patch at the base of the hind-wing underside. This brown patch is especially noticeable in many species of *Planema* and also in their mimics. The case was further complicated by the fact that in West Africa the male *alciope* formed the model of the female *Mimacraea fulvaria*,

* In the hurry of his departure for Africa, Mr. Neave erroneously described the examples of *aurivillii* in the Wiggins collection (Novit. Zool., Vol. II, 1904) as males. They are certainly females, as are all the specimens, some fifty or more, examined by me.—H. E.

Auriv., whilst the male of this *Lycaenid* accurately resembled a male *Planema* allied to that which formed the model of the female *alciope*. All the species involved were exhibited, the female *Lycaenid* being represented by an imitation specimen made of paper and copied from Aurivillius's figure, there being no example of the female in this country. The mimetic relations might be illustrated diagrammatically in the following manner, the arrows expressing the connection of model and mimic, and pointing from the latter to the former.



One result of the investigation was that the *alicia* of Smith and Kirby could no longer stand, firstly because it was an *Acraea* and not a *Planema*, secondly because the name was preoccupied, thirdly because the alleged male was a female, and fourthly because the female was the same as *aurivillii*, and *aurivillii* was *alciope*. The latter might be retained as a varietal name for the East African female.
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Mr. ELTRINGHAM said he would like to express his sincere thanks to Dr. Jordan, to whom to a great extent the result of the investigation was due.

PROBABLE MIMETIC ASSOCIATION OF ACULEATE HYMENOPTERA.

—The Rev. F. D. MORICE brought for exhibition a number of specimens of Aculeate Hymenoptera which he suggested formed probably a Müllerian group. Though belonging to several widely separated genera they were on the whole very similarly coloured (most of them *e. g.* having yellowish-hyaline wings with black tips). All were taken on a single occasion visiting the small yellow flowers of one particular tree in the alluvion of the Wady Kelt, near Jericho. Another specimen

of the same tree grew close by, but no other (in spite of careful search) could be found anywhere in the neighbourhood. Nor had the exhibitor, except on this one occasion, encountered several of the largest and most striking species then taken in the course of three weeks spent at Jericho and devoted entirely to the search for Hymenoptera. The tree has since been identified as one of the *Chenopodiaceae*—*Ochrademus baccatus*, Del. The insects included the magnificent *Sphex hirtus*, Kohl, a large *Pompilus*, probably *P. vespiformis*, Klug, also *Eumenes dimidiatipennis*, Sauss., and an enormous *Odynerus* (apparently undescribed), whose coloration both of body and wings exactly reproduced that of the *Eumenes*.

Professor E. B. POULTON, F.R.S., agreed with the exhibitor that this was apparently a Müllerian group, and referred to similar groups observed by Mr. G. A. K. Marshall in South Africa and described in the Society's Transactions. The insects, he said, while alive and in flight would appear even more similar in their general appearance, than as now when pinned in the carton.

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TERATOLOGICAL EXAMPLE OF A CARABID.—Dr. G. B. LONGSTAFF showed a teratological specimen of a Carabid beetle from Ceylon (*Omphra*, Latr., sp.). The middle femur of the right side was dilated at the distal end, bearing at its anterior angle two supplementary tibiae coherent at the base; the rudimentary tarsi were also adherent.

Wednesday, December 1st, 1909. [lxxii]

LATE AUTUMN COLEOPTERA.—Commander J. J. WALKER exhibited 128 species of Coleoptera, belonging to 68 genera, which he had taken, by sweeping only, at Wytham Park, Berks. between 12.30 and 3.30 p.m. on November 5th, 1909.

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Several local and uncommon species were included among these, such as *Homalota puberula*, Sharp, *Anisotoma cinnamomea*, Panz. (both sexes), *A. punctulata*, Gyll., *Hydnobius punctatissimus*, Steph., *Cryptophagus pubescens*, Sturm, *Phloeophilus edwardsi*, Steph., *Mantura matthewsi*, Curt., *Salpingus castaneus*, Panz., *Apion filirostre*, Kirby, etc., etc.

Report of the Hope Professor of Zoology, 1908.

The pages of the following Report indicate that the Hope Department has received much generous help during the year 1908. It is unnecessary to mention any special gifts at this point, for all are fully described below. The absolute necessity for increased space must again be emphasized. The difficulty in affording opportunities for students is, under present circumstances, even greater than that encountered in the attempt to house fresh material.

1. *Financial Gifts and Grants to the Department.*

The sum of £175 was spent on cabinets during the year 1908; a set of 10, containing 200 interchangeable drawers of the Department pattern, being received. Towards the cabinet fund, from which this payment was made, £100 was received from the Common University Fund and £100 from the Professor, who also contributed £40 for the expenses of work upon the collections of *Pierinae*. Dr. G. B. Longstaff renewed his generous grant of £78 for meeting the expense of an extra assistant. Great encouragement in the work of the Department was received from the generous and kindly decision of Brasenose College to grant a sum of £185 towards the general expenses. This sum will be spent during the present year in the provision of further cabinet accommodation.

2. *The A. J. Chitty Collection.*

This important collection of British insects was presented by Mrs. A. J. Chitty. The long series of species, accompanied by excellent data, will do much to encourage the study of insects in the University, and will be an enduring memorial of the keenest of naturalists, A. J. Chitty of Balliol.

In spite of the fact that the specimens were very insecurely fixed in their boxes and cabinet drawers, the collection was brought by road from London, and transferred to the Department in safety—a result in great part due to careful superintendence of the packing by Mrs. Chitty, Mr. Guy A. K. Marshall, and the Professor.

3. *Work done by the Staff.*

Mr. Shelford's work on the Orthoptera, and Dr. Dixey's on the *Pierinae*, are described in the two following sections. An account of the kind assistance rendered by Commander Walker is given in Section 6.

In addition to the ever-recurring labour of incorporating accessions, Mr. Holland has arranged the extensive British collection of Pyrales and Tortrices, incorporating the large and beautiful collection of British Micro-Lepidoptera pre-

sented by Mrs. Bazett. He also rearranged the *Satyrinae*, which had entirely outgrown the space originally allotted to them, and arranged the American and Eastern *Papilioninae*. In the former work he followed the order of the British Natural History Museum, a manuscript list of the species having been most kindly prepared for this purpose by Dr. G. B. Longstaff. In the arrangement of the *Papilioninae*, Rothschild and Jordan's masterly monograph was followed. The American Papilios were very kindly named by Dr. Jordan, and the determinations of the Eastern species confirmed by him on one of his visits to the Department. In addition to this important work on the Lepidoptera, Mr. Holland brought together and made a preliminary arrangement of the material belonging to the Coleopterous groups,—*Staphylinidae*, *Pselaphidae*, and *Scydmaenidae*; at the same time sorting into their proper groups a large number of Coleoptera scattered through the Collection, and fusing together the separate collections belonging to the same group. He also spent much time in putting fresh naphthaline in the drawers and in classifying and making a preliminary list of a very large collection of butterflies presented by Mr. C. F. M. Swynnerton from Chirinda Forest, Gazaland, S.E. Rhodesia.

Mr. A. H. Hamm completed the resetting of the general collection of butterflies, a great piece of work, upon which he has been engaged intermittently for many years. The groups finished in the course of 1908 were the *Papilioninae*, *Satyrinae*, *Acracinae*, *Heliconinae*, and the last part of the *Nymphalinae*. Much of his time was also occupied in setting and printing labels for the specimens collected by Dr. Longstaff in Ceylon; incorporating the fine accessions of British Diptera presented by Col. J. W. Yerbury, and bringing together the great collection of Majorcan and Spanish specimens for cataloguing. Mr. Hamm also expended much time upon the collection of Diptera and the valuable series of Asilid flies from the Bigot Collection presented by Mr. G. H. Verrall.

Col. Yerbury's collection of British Diptera provided the largest single piece of work undertaken by Mr. J. Collins

during the year. The determinations required a printed label separate from that bearing the other data, and the extent of the labour involved may be inferred from the numbers quoted on p. 24 below. Mr. Collins also printed labels for, and catalogued numbers of smaller accessions, and assisted in the labelling of others. He fixed printed labels with all available data to many groups of the Miers Collection, the W. W. Saunders Collection, and the Malcolm Burr Collection, so that the specimens could be placed side by side with others without losing the record of their history. Another considerable piece of work was the preparation of labels with full data for the numerous "types" in the *Blattidae*, *Phasmidae* and *Mantidae*, and of labels with determinations of species for the collections presented by Dr. Longstaff; for Hymenoptera named by the late Col. C. T. Bingham, &c. He also assisted Mr. Hamm in repapering a number of the old cabinet drawers.

4. *Work on the Collections of Orthoptera.*

The following Report has been written by Mr. R. Shelford, M.A., F.L.S., F.E.S.:—

The collection of *Blattidae* has increased in size so considerably during the past year that it has extended beyond the limits of space originally allotted to it. Five extra drawers have been added to the cabinet in which the collection is arranged, but if the past rate of increase is maintained, this additional accommodation will soon prove insufficient.

The numerous sources whence the additional specimens have been received are detailed in another part of this Report. Collections received from the following Museums have been determined and returned:—Brussels, Deutsches Entomologisches National-Museum (Berlin), Hamburg, Madrid, Wiesbaden; duplicates from these collections have been presented to the Hope Department and the new species contained in them have been described in memoirs that have already appeared or are shortly due to appear. Further collections for determination were received during the year from the following Museums:—British Museum (S. A. Neave Collec-

tion); Brussels Museum (Dr. Sheffield Neave Collection); Musée Royal du Congo, Brussels; Senckenberg Museum, Frankfurt-on-Main; St. Petersburg Museum; South African Museum. A monograph on the *Blattidae* of the World is now in course of preparation, and promises to be a work of some years; this family of insects has been much neglected by entomologists during the past ten or twelve years, and the number of undescribed or imperfectly known species is considerable.

The arrangement of the collection of *Phasmidae* is now completed; the insects occupy 115 drawers and are represented by 1,498 specimens belonging to 168 genera and 510 species; there are 186 types, and 50 species appear to be new to Science. Professor Westwood devoted special attention to this family of Orthoptera, and published a classic memoir on them. H. W. Bates also described the new species contained in the Wilson Saunders Collection. On account of its richness in type-specimens of Westwood and Bates, the Hope Collection of *Phasmidae* is the most important one in the country.

A list of the *Phasmidae* of the Godman-Salvin Collection was drawn up for publication in the *Biologia Centrali-Americana*, and the duplicates which were kindly presented by Dr. F. D. Godman, Hon. D.C.L., F.R.S., filled some important blanks in our cabinets. Dr. J. L. Hancock of Chicago again kindly determined a collection of *Tetriginae* (*Aceridiidae*), and published a memoir on the results of his study; the collection was not very large, but it included no less than 11 new genera and 37 new species.

The arrangement of the *Locustidae* was commenced, but a report on this collection is deferred until next year, when it is hoped the work on it will be completed.

5. *Work on the Collection of Pierinae.*

Dr. F. A. Dixey continued his work on the *Pierinae*, paying especial attention to the difficult genus *Pinacopteryx*, many remarkable forms of which have reached the Hope Collection from Rev. K. St. A. Rogers, Mr. Neave, and Mr. Wiggins.

The available material is probably still insufficient for a complete elucidation of the group, but Dr. Dixey hopes that his investigations when finished will result in a nearer approximation to a knowledge of the affinities of its various members than we at present possess. Much time was also given to the incorporation of new specimens with the general collection, in particular the interesting series collected by Dr. G. B. Longstaff in Venezuela, Trinidad, and the West Indies.

6. *Rearrangement of the British Beetles.*

Commander Walker has continued his most kind assistance in getting the fine Hope Collection of British beetles into order and arranging it with the addition of all the accessions of the last sixteen years, including Mr. Holland's fine series, briefly described in last year's Report, and Mr. H. St. J. K. Donisthorpe's donations, amounting at the present time to no fewer than 1,403 species.

The Hope specimens belonging to the Hydradephaga and Philhydrida were completed in 1908, and the Lamellicorns early in the present year. Work upon the *Elatridae* and *Buprestidae*, begun in 1908, is now very nearly completed.

7. *Work upon the Burchell Collections.*

Mr. J. C. Moulton, B.A., Magdalen College, completed his list of the *Nymphalinae*, the largest and most important group of butterflies collected by W. J. Burchell in Brazil (1825-30). This valuable piece of work has involved a critical examination and careful comparison with the original notebooks of the manuscript records on over 800 specimens, a minute study of all the species, and the description of new species and varieties. Large numbers of specimens were taken to London to be compared with the series in the Godman-Salvin and British Museum Collections. In this work much kind help was afforded by Mr. F. A. Heron, M.A., New College, and in the descriptions by Mr. Roland Trimen, Hon. M.A., F.R.S. The results of Mr. Moulton's

work have been published in three papers in the *Annals and Magazine of Natural History*, one in Aug., 1908, p. 165, and two early in the present year (Jan., p. 7; Feb., p. 98), since the author's departure to Borneo in order to undertake the Curatorship of the Sarawak Museum.

8. *Assistance in Working out the Material of the Department.*

The lamented death of Col. C. T. Bingham, F.Z.S., F.E.S., deprived this Department of the University of a very kind friend, who has rendered valuable help during many years. At the time of his death Col. Bingham was engaged in working out the very large collections of South African Hymenoptera Aculeata in the Hope Department.

This material not only includes the species in the large W. W. Saunders Collection, but several more recent accessions of great extent—notably those presented by Mr. Guy A. K. Marshall, Dr. F. N. Brown, Mr. S. A. Neave, and Dr. G. B. Longstaff. The manuscript of Col. Bingham's monograph on "South African Aculeate Hymenoptera in the Oxford Museum" is complete as regards the *Mutillidae* and *Scoliidae* and contains part of the *Pompilidae*. Numbers of new species are described, and obscure and doubtful points cleared up in the paper, which will be of great value to the student of Ethiopian Hymenoptera.

Colonel J. W. Yerbury very kindly made a special visit to Oxford, as he has done in many previous years, in order to help in the arrangement and determination of the Diptera. He arranged the *Cyrtidae*, a most interesting and peculiar group of flies specially studied by Professor Westwood. All the types are identified and clearly labelled, and the whole group is now in a most satisfactory condition. Col. Yerbury also examined and confirmed the arrangement of the British species incorporated into the Collection since his previous visit, and himself incorporated the numerous accessions to the general collection of *Asilidae*. He also brought together the material belonging to the *Tabanidae* in prepara-

tion for the working out and arrangement of that family. Mr. G. H. Verrall, F.E.S., and Mr. J. E. Collin, F.E.S., also rendered much kind assistance in this Order of Insects.

The kind help of Dr. F. D. Godman, Hon. D.C.L., F.R.S., in naming the South American *Hesperidae* has been acknowledged in an earlier Report. The Old World species have been very kindly undertaken by Mr. Hamilton H. Druce, F.L.S., F.E.S. This great work is now complete and the specimens have been brought back to the Department. As soon as Mr. Druce's determinations have been placed upon them, the whole collection will be arranged in the order followed in the British Natural History Museum. No published list of this series exists, but Dr. G. B. Longstaff most kindly undertook the labour of copying out the names of the entire family, together with those of the *Satyrinae*. The latter sub-family has been arranged in accordance with his list, and the *Hesperidae* will be undertaken during the present summer. Dr. Longstaff has also expended much time and labour both in London and Oxford, in working out the material presented by him to the Department. On this material and on his observations he has published the papers mentioned in Section 10.

In the difficult groups of the South American *Papilioninae* the mimetic resemblances are so perfect and misleading that the classification believed to be based on affinity has been entirely falsified in nearly every Museum. Now, however, that Rothschild and Jordan have published a splendid monograph on these very groups, establishing their true relationship by the study of structure, the difficulty is at an end. The whole of the University material was reset and, packed in about 70 boxes, was conveyed by hand to Tring. In spite of the immense number of specimens, the collection was so rapidly determined by Dr. Karl Jordan that only two visits were required. Mr. J. C. Moulton, B.A., Magdalen College, kindly assisted the Professor on one of these occasions. Dr. Jordan's identifications have now been affixed to all the specimens.

The kind help afforded by Mr. Roland Trimen, F.R.S., is indicated in Section 10.

Dr. T. A. Chapman, F.Z.S., F.E.S., in the course of his

recent researches upon the *Lycænidæ*, formerly placed in the genus *Cyaniris*, has investigated the Department material which bore upon his inquiries. Mr. Edward Saunders, F.R.S., has continued to work at the collection of Greek Hymenoptera Aculeata made by his cousin, Sir S. S. Saunders. Mr. F. Balfour Browne, M.A., F.E.S., has determined a number of specimens belonging to the most obscure and difficult species of the British Water Beetles. Dr. Creighton Wellman has made a preliminary study of the *Cantharidæ*. Mr. Roland E. Turner, F.E.S., has studied the Tasmanian Hymenoptera of the W. J. Burchell Collection, and has identified a number of the species. Mr. Turner has also worked out the Department material in the groups of Hymenoptera upon which he has recently published memoirs. Mr. W. J. Lucas, B.A., and Mr. E. R. Speyer, New College, have rendered assistance with the collection of Neuroptera.

The Cetoniid beetles are being sent in sections to Mr. O. E. Janson, F.E.S., who has most kindly consented to work out the collection gradually. His determinations have now been placed on all specimens of the sections already completed; and the same is true of the *Buprestidæ*, kindly named in the British Museum by Mr. G. A. K. Marshall. The African Longicorns, kindly identified by Dr. Karl Jordan at Tring, are in part labelled with their determinations, and will soon receive the whole.

Mr. E. E. Green, F.E.S., during his visit to Oxford, kindly named a number of the *Coccidæ*, taking others away for prolonged study. These he has now identified and returned.

Monsieur H. Boileau, of Paris, visited the Department and examined the collection of *Lucanidæ*. He took away and kindly worked out a number of the difficult species, which have now been returned in safety. It is hoped that this distinguished authority on the group will soon publish a paper on the Lucanid beetles of the Department.

As regards the bionomic collections, in addition to the work which is sufficiently indicated in the list of publications printed in Section 10, Dr. F. A. Dixey, Dr. G. B. Longstaff, and the Professor selected, arranged, and exhibited specimens

illustrating mimicry, &c., at the Soirée of the Entomological Society on May 15, and at that of the Linnean Society on July 1, in commemoration of the fiftieth anniversary of the publication of the theory of Natural Selection. These illustrations will be permanently retained in the bionomic series of the Department. Very efficient assistance was rendered by Mr. A. H. Hamm in preparing these exhibits, and printing labels for them.

In another piece of bionomic work, as yet unpublished, Mr. Guy A. K. Marshall afforded kind assistance, viz.: the determination of species and preparation of a list of the very large numbers of specimens from Chirinda Forest, Gazaland, S. E. Rhodesia, presented by Mr. C. F. M. Swynnerton. It is hoped that, with Mr. Swynnerton's and Mr. Marshall's kind help, considerable light may be thrown upon the bionomics of African butterflies by the careful study of the relationship between the species in this isolated patch of primitive forest. Mr. W. Holland has devoted much time and care to classifying the specimens according to their species and dates of capture, and making the list.

In speaking of the help received by the Department, the Professor desires to thank Mr. A. Cant for the great care and skill he has bestowed upon the specimens—often very small and extremely delicate—entrusted to him for setting.

9. *Visits of Naturalists, &c.*

The following visits are independent of those alluded to in the last section:—

The visit of the Council of the Entomological Society took place on July 4-6. The following members were present:—Commander J. J. Walker (Secretary), Mr. A. Harrison, Dr. G. B. Longstaff, Mr. G. A. K. Marshall, Professor L. C. Miall, F.R.S., and the Professor. The Hope Curators were represented by the Junior Proctor and the Professor. The following Fellows of the Entomological Society were also present, students of many sections of the Hope Collection:—Mr. R. Adkin, Mr. H. St. J. Donisthorpe, Mr. Harry Eltring-

ham, Mr. C. J. Gahan, Mr. E. E. Green, Mr. F. Merrifield, and Mr. Roland Trimen, F.R.S. The party was very kindly entertained in the garden of Merton College, on the evening of July 5, by Mr. E. S. Goodrich, F.R.S.

Mr. Eustace R. Banks, F.E.S., has visited the Department to study the Haworth types of British Micro-Lepidoptera; Mr. Louis B. Prout, F.E.S., to study the types of *Geometrina*; Mr. Victor E. Shelford, of Chicago University, the collection of *Cicindelidae*; Mr. H. Eltringham, F.E.S., the examples of mimicry in butterflies.

The following entomologists have also visited the Hope Department:—Professor A. Böving, of the Copenhagen Museum; Mr. Edward Meyrick, F.R.S.; Monsieur Léon Dufour; Mr. Selwyn Image, F.E.S.; and Mr. Walter W. Froggatt, Government Entomologist, New South Wales. It was a particular pleasure to welcome Professor and Mrs. Comstock, of Cornell University, and to show them something of the work and methods of the University Collections.

The Department was also visited by Professor J. C. Ewart, F.R.S.; Professor J. S. Kingsley; Professor Chancey Juday, of the Wisconsin State University, Madison; and Mr. Benjamin Kidd.

It was a great pleasure to be able to show a part of the W. J. Burchell Collection to Mr. Francis A. Burchell of the Rhodes University College, Grahamstown, great-great-nephew of the illustrious naturalist, and one who has done such invaluable work in the recovery of manuscripts and letters.

10. *Work published in 1907.*

The following papers by workers in the Hope Department, or upon its material, have appeared in the Transactions of the Entomological Society of London during the year 1908:—

Read Nov. 6, 1907.—Notes on some Butterflies taken in Jamaica, by G. B. Longstaff, D.M., F.R.C.P., F.E.S., New College.

Read Nov. 6, 1907.—On some of the Butterflies of Tobago, by Dr. G. B. Longstaff.

Read Feb. 5, 1908.—On Diaposematism, with reference to some limitations of the Müllerian Hypothesis of Mimicry, by Guy A. K. Marshall, F.Z.S., F.E.S. This important paper, although not strictly dealing with Oxford material, initiates a controversy upon certain theoretical conclusions based on work done in the Department. By Mr. Marshall's courtesy it will be included in the seventh volume of Hope Reports, together with other contributions to the discussion.

Read June 3, 1908.—Further studies of the *Tetriginæ* (Orthoptera) in the Oxford University Museum, by J. L. Hancock, M.D., F.E.S. (Chicago).

Read June 3, 1908.—Hereditv in six families of *Papilio dardannus*, Brown, Subspecies *cenca*, Stoll, bred at Durban by G. F. Leigh, F.E.S., by the Professor.

Read Nov. 20, 1907.—Mimetic North American species of the Genus *Limnitis* (s. l.) and their models, by the Professor.

Read Dec. 4, 1907.—Some bionomic notes on British East African Butterflies, by the Rev. K. St. Aubyn Rogers, M.A., F.E.S., Wadham College; with further notes and descriptions by the Professor and an appendix containing the description of new British East African forms, by Roland Trimen, Hon. M.A., F.R.S., &c.

Read Oct. 21, 1908.—On Müllerian Mimicry and Diaposematism, a reply to Mr. G. A. K. Marshall, by F. A. Dixey, D.M., Wadham College, Oxford.

Read June 3, 1908.—On some of the principal Mimetic (Müllerian) Combinations of Tropical American Butterflies, by J. C. Moulton, B.A., F.E.S., Magdalen College.

Read Oct. 7, 1908.—Bionomic notes on Butterflies, by Dr. G. B. Longstaff.

The following short papers have appeared in the Proceedings of the Entomological Society of London during the year 1908:—

February 3.—Exhibition by Commander J. J. Walker of very young larvae of *Sitaris muralis*, obtained by Mr. A. H. Hamm from ova laid by females in captivity.

Mimicry in the Butterflies of Mauritius and Bourbon, by the Professor.

Secondary Mimetic Resemblance of *Ithomiinae* to the Danaine genus *Itana*, by the Professor.

Mimetic Relation of *Nychitona* and *Pseudopontia*, by Dr. F. A. Dixey.

Mr. S. A. Neave's observations on the habits of *Pseudacraea poggei*, and the blue species of *Crenis*, with their mimic, by the Professor.

April 1.—Observations on the habits of *Ochromyia jejuna*, and on the structure of its tongue, by Mr. E. E. Green, F.E.S., communicated by the Professor.

May 6.—*Blattidae* in Amber, by R. Shelford.

Mr. S. A. Neave's discovery of a remarkable Oestrid fly (*Spathicera*) following *Rhinoceros bicornis*, by the Professor.

Mr. H. Leslie Andrewes's observations on the Bulbul feeding its young on specially protected insects, by the Professor.

Dr. Karl Jordan's observations on predaceous Asilid flies, by the Professor.

On the species of *Neptis* in the Islands to the E. and N.W. of Madagascar, by the Professor.

October 7.—Mimicry of the *melpomene*-like *Heliconii* by other groups of South American Butterflies, by Dr. F. A. Dixey.

October 21.—Mr. G. F. Leigh's proof of the specific identity of *Charaxes neanthes* and *C. zoolina*, by the Professor.

A reply to Dr. F. A. Dixey's paper "On Müllerian Mimicry and Diaposematism, &c.," by Guy A. K. Marshall.

November 4.—A Phasmid bred parthenogenetically by Mr. H. Main, by R. Shelford.

The Double or Combined Aposeme, by Dr. F. A. Dixey.

Mr. G. L. Clark's discovery of *Glocia clarki* near Durban, by the Professor.

Mr. S. A. Neave's observations on a mimetic *Euphaedra*, by the Professor.

D. chrysippus and its mimics taken together on a patch of Zinnia at Jinja on the N. shore of the Victoria Nyanza by Mr. C. A. Wiggins, by the Professor.

Mimetic relation between *Colaenis telesiphe*, *Heliconius telesiphe*, &c., by Dr. F. A. Dixey.

December 2.—Mr. Keynes's observations on the drinking habits of *Limenitis*, by the Professor.

Mimicry by *Colaenis telesiphe* and *Belenois thysa*, probably Müllerian, by Dr. F. A. Dixey.

In addition to the above-named communications recorded in the publications of the Entomological Society, the following papers have appeared in the course of the year 1908.

On the Lepidoptera Rhopalocera collected by W. J. Burchell in Brazil, 1825-30. VI. Nymphalinae, by J. C. Moulton, B.A., F.E.S., Magdalen College. In the Annals and Magazine of Natural History for Aug. 1908, pp. 165-95.

Observations on *Empis livida*, by A. H. Hamm. In Entomologist's Monthly Magazine, 1908, pp. 181-4.

Notes on the British Dragon-flies of the Dale Collection, by W. J. Lucas, B.A., F.E.S. In Entomologist's Monthly Magazine, 1908, pp. 198-203.

On Diaposematism, or the Interchange of Characters between Distasteful Forms, by Dr. F. A. Dixey. In Report of the Dublin Meeting of the British Association (1908).

Mr. R. Shelford's monographs and papers on Orthoptera are printed in the following list:—

I. BLATTIDAE.

1. Sub-fam. *Phyllodromiinae* in Genera Insectorum, fasc. 73.

2. Sub-fam. *Nyctiborinae* in Genera Insectorum, fasc. 74.

3. Some new Genera and species of *Blattidae*, with notes on the form of the Pronotum in the sub-family *Perisphaeriinae*. Ann. Mag. Nat. Hist., ser. 8, vol. i. p. 157.

4. On a small collection of *Blattidae* in the Naturhistorisches Museum zu Wiesbaden. Jahrb. Nassau. Ver. Natk., vol. 61, p. 27.

5. New species of *Blattidae* in the collection of the Deutsches Entomologisches National-Museum. Deutsch. Ent. Zeitschr., 1908, p. 115.

6. Some new species of *Blattidae* in the Brussels Museum. Mém. Soc. Ent. Belg., vol. xv. p. 227.

II. PHASMIDAE.

1. *Phasmidae*. In *Biologia Centrali - Americana*, Orthoptera, vol. ii.

11. *Sixth volume of Hope Reports.*

The sixth volume was issued on June 26, and contains separata of octavo publications which appeared in the course of the two years before that date. The volume includes 25 memoirs, in addition to a large number of short papers from the Proceedings of the Entomological Society, and two years' reports extracted from the OXFORD UNIVERSITY GAZETTE. The book is rather too bulky, an inconvenience which will be avoided in future by issuing the volumes at shorter intervals.

ADDITIONS TO THE COLLECTIONS IN 1900.

Three very interesting series of the weevil, *Cleonus sulcirostris*, (1) from the reddish sand of Boar's Hill, (2) from dark earth on Shotover Hill, and (3) from the Deal sand-hills, were presented by the captor, Mr. W. Holland. The specimens, which had been overlooked in cataloguing in previous years, are coloured in correspondence with the surface of their respective localities (Trans. Ent. Soc. Lond., 1899, p. 430).

ADDITIONS TO THE COLLECTIONS IN 1901.

The very large collection of insects made in 1901 by the Professor, Mr. Holland, and Mr. Hamm, in Majorca, near Barcelona, and at the eastern end of the Pyrenees, has now been catalogued and incorporated—a considerable labour, as may be inferred from the following numbers. The Hymenoptera Aculeata, the *Blattidae* and *Forficulidae*, catalogued in previous years, are omitted from the list. Each specimen possesses its printed label on which the name of the captor and donor is recorded, so that it has not been thought necessary to discriminate between the captures in the catalogue. The numbers are even larger than those quoted, inasmuch as the insects mounted on a single card are always counted as one.

Groups of Insects from Majorca, N. E. Spain, and E. Pyrenees :—

LEPIDOPTERA—			Number of specimens catalogued.	Total number of specimens.
RHOPALOCERA—				
<i>Satyrinae</i>	...	...	238	412
<i>Nymphalinae</i>	...	...	78	96
<i>Erycinidae</i>	...	...	7	11
<i>Lycacnidae</i>	...	...	119	216
<i>Papilioninae</i>	...	...	9	18
<i>Pierinae</i>	...	...	103	158
<i>Hesperidae</i>	...	...	31	60
Total	...	...	585	971
LEPIDOPTERA—				
HETEROCERA	...	...	391	550
DIPTERA	...	...	927	1203
COLEOPTERA	...	...	1073	1927
HYMENOPTERA (exclu- sive of Aculeata)	...	...	168	168
RHYNCHOTA (principally Hemiptera)	...	...	515	1218
NEUROPTERA—				
ODONATA	...	...	120	237
Other than ODONATA	...	...	59	84
ORTHOPTERA—				
<i>Forficulidae</i>	...	...	6	6
<i>Blattidae</i>	...	...	0	8
<i>Phasmidae</i>	...	...	3	3
<i>Mantidae</i>	...	...	0	3
<i>Gryllidae</i>	...	...	7	7
<i>Locustidae</i>	...	...	33	42
<i>Acridiidae</i>	...	...	325	496
Insecta Totals	...	...	4212	6923

In addition to the Insecta a few examples of other Arthropod groups have been catalogued and added to the Collections:— of the Arachnida, 24 Arancina and 8 Acarina (with 3 uncatalogued specimens); of the Myriopoda, 5 examples.

A small set of 30 insects of various Orders from Cyprus (chiefly Nikosia), captured in 1901, and presented by Miss Dorothea M. A. Bate, have been labelled and incorporated. These specimens are in addition to the valuable series from Cyprus, due to the kindness of the same donor, and acknowledged in an earlier report.

ADDITIONS TO THE COLLECTIONS IN 1902.

The following outstanding British specimens have now been labelled and incorporated:—12 *Clostera anachoreta* bred at Oxford (April, 1902), and presented by Mr. W. Holland, together with 4 examples of the second brood (July 3, 1902). The moths are descendants of those reared from the ova found at St. Leonards in August, 1893, by Miss Edwards (Entomologist, 1893, p. 361; 1908, p. 272).

ADDITIONS TO THE COLLECTIONS IN 1903.

Considerable progress was made during 1908 with the cataloguing and incorporation of the great collection of Orthoptera presented in 1903 by Malcolm Burr, Esq., B.A., New College.

The following groups were completed:—

<i>Acridiidae</i>	.	.	285 specimens (all <i>Tetriginae</i>).
<i>Phasmidae</i>	.	.	201 „
<i>Locustidae</i>	.	.	364 „

Large numbers of specimens were also provided with printed locality labels, and the *Tetriginae* with Dr. G. L. Hancock's determinations. In addition to the catalogued specimens, numbers of others in a less perfect condition were added to the Collections.

ADDITIONS TO THE COLLECTIONS IN 1905.

A valuable series of insects, principally butterflies, of which 128 have been catalogued and many others added to the Collections, was presented by Commander J. J. Walker. The data are full and precise, and localities very numerous, includ-

ing—Gibraltar and S. Spain (1887-9), N. Morocco (1887), Malta (1893), Gallipoli (1878), S. W. Africa (Elephant Bay, H. W. Walker, 1883), E. China (1892-3), Chusan Islands (1892), Moluccas (1891), Lesser Sunda Islands (1890-1), Louisiade Islands, Torres Islands (1900), New Hebrides (1900), New Caledonia (1900), Tahiti (1883), Australia (1902-4), Tasmania (1900-4), New Zealand (1901), Mexico, Panama (1881-2), Ecuador (1881), Peru (1881-4), Chili (1881-4), Patagonia (1880), Straits of Magellan (1881).

In addition to this most interesting series, containing several species entirely new to the Collections, two examples of *Eupithecia extensaria*, from King's Lynn, were presented to the British Collection of Lepidoptera by the same kind donor.

An interesting series of 135 butterflies, chiefly *Pierinae*, captured by a native collector in May, 1905, at Taveta, British East Africa (2,500 ft.), presented by C. A. Wiggins, Esq., have now been incorporated, and the majority catalogued as permanent accessions.

ADDITIONS TO THE COLLECTIONS IN 1906.

Several outstanding donations, especially from the Ethiopian Region, have now been catalogued and incorporated. The joint gift of the British South African Company and Mr. S. A. Neave, and that of Mr. C. A. Wiggins are especially fine and extensive. The British accessions are placed at the end of the section, and not under a separate head.

A valuable set of insects, Arachnida and Acari, from Baviaan Krantz, in the Orange River Colony, 20 miles above Orange River Station (Sept. 1905-Mar. 1906), and from the neighbourhood of Cradock, Cape Colony (Oct.-Nov. 1905), was presented by the captor, F. B. Parkinson, Esq. One hundred and eighty-seven specimens were catalogued, and many others incorporated in the Collections. The data are precise and full. The insect Orders principally represented are the Coleoptera, Hymenoptera, and Orthoptera.

The cocoon, probably of a Myrmecleonid from Baviaan Krantz (Oct. 9, 1905), was presented by Professor C. V. Boys, F.R.S., together with 3 insects captured on board the

"Kinfauns Castle" (Oct. 1905). The cocoon is accompanied by interesting notes of the donor's observations.

It has been a great satisfaction to incorporate an important part of the very large and varied collection made in 1904-5 in Northern Rhodesia and presented by S. A. Neave, Esq., M.A., B.Sc., Magdalen College. The British South African Company, who had appointed Mr. Neave as Naturalist, generously consented to present their share of the insects and other Arthropoda to the Hope Department. The name of the Company and that of Mr. Neave are printed together as joint donors on the label placed upon every specimen. The Manchester Museum, which contributed to the cost of the expedition, is receiving a series of named, set, and fully labelled specimens of the species of each group as it becomes ready to be incorporated into the Oxford Collection. Such incorporation except on a small scale could not be undertaken until quite recently, because it was important that Mr. Neave should be able to compare his earlier collections as a whole side by side with those which he has since made in the same and neighbouring districts. The area covered by Mr. Neave's expeditions is of especial interest to the Hope Department. Owing principally to Mr. Guy A. K. Marshall's generosity, the Department is very rich in the insects of Southern Rhodesia and Natal, but from the Zambesi northward the representation of species is scanty as far as British East Africa and Uganda, the area which supplied the splendid material presented by Mr. C. A. Wiggins and the Rev. K. St. A. Rogers. Mr. Neave's collections now fully represent an important section of the intervening area. Mr. Neave's expeditions in 1904-5 were undertaken in the southern half of the valley of the Loangwa River, from its entrance into the Zambesi upwards, on the very interesting high plateau (about 4,000 ft.) to the west, and the lower plateau (chiefly at a height of about 2,400 ft.) to the east. On the latter side, where most of the collecting took place, the expeditions were often traversing Portuguese territory. A great deal of work was done in the low valley itself at heights ranging from 1,200 to 1,500 feet. The following butterflies from the area thus briefly described have

been catalogued and incorporated. A number of species are still being investigated by Mr. Neave, and these will be added to the Collection at a later date.

<i>Danainae</i>	.	.	.	.	21
<i>Satyrinae</i>	.	.	.	.	85
<i>Nymphalinae</i>	.	.	.	.	194
<i>Acraeninae</i>	.	.	.	.	301
<i>Erycinidae</i>	.	.	.	.	3
<i>Lycaenidae</i>	.	.	.	.	310
<i>Pierinae</i>	.	.	.	.	166
<i>Papilioninae</i>	.	.	.	.	23
<i>Hesperidae</i>	.	.	.	.	175
Total	.	.	.	.	1278

In addition to these catalogued specimens immense numbers of others in a rather less perfect condition have been added to the Collection, together with 17 catalogued specimens for the bionomic series.

A very large and valuable collection of insects of many Orders, taken in 1905 at Kilindini (Mombasa), British East Africa, and in 1906, at Jinja (3,775 ft.) and other localities in Usoga, on the N. shore of the Victoria Nyanza (Luba's, Usakira, Kajaia's, Naniumba's), was presented by the captor, C. A. Wiggins, Esq. No less than 1,508 specimens have been catalogued and incorporated. The Orders principally represented were the Coleoptera, Rhynchota, Hymenoptera, and Orthoptera (especially the *Acridiidae*). Several nests, together with their Hymenopterous builders, were of especial interest. The Lepidoptera, although not numerous, included many species greatly wanted in the Collection, such as *Salamis cacta* and a *Euxanthe* hitherto unrepresented in the Department. The data are excellent, as in all specimens collected by the donor. A large amount of labour has been expended upon this very fine accession. In addition to the above, a very interesting series of 23 butterflies, taken in the course of half an hour (Feb. 21, 1906) on a patch of *Zinnia* at Jinja, was presented to the bionomic collections by the same generous donor. With the exception of a single

Lycaenid, the whole series consisted of *Danaida* (*Linnaus*) *chrysippus* and its mimics. Although no single specimen of the *dorippus* (*klugii*) form was present among the 17 *chrysippus*, examples of its mimics occurred both in the female of *Hypolimnaus misippus* (2 out of 3 were of the *inaria* form), and in *Acraea eucedon* (1 out of 2 was of the *daira* form). This interesting evidence of the spread of a mimicking form beyond the range of its model was exhibited to the Entomological Society of London (*Proceedings*, 1908, p. lxxx).

In addition to the above, an interesting series of 27 butterflies and 1 moth from forest-land (about 2,500 ft.) at Taveta, British East Africa (March 7, 1905), were presented by the captor, C. A. Wiggins, Esq., M.R.C.S., together with 20 butterflies from Mombasa (1904-5) and 28 butterflies and 1 moth from Chagamwe, on the Uganda Railway, about 10 miles inland from Mombasa (Dec. 23, 1904). These latter include 11 specimens of the interesting Lycaenid *Teriomima freya* captured at rest together on a single flower-stem.

A Syrphid fly from the neighbourhood of Salisbury, Mashonaland, was presented by the captor, G. A. K. Marshall, Esq.

A male specimen of the Danaine butterfly, *Amauris albi-maculata*, from the Aberdare Range, in the Kenia Province of British East Africa (Feb. 1906), was presented by the captors, S. L. Hinde, Esq., and Mrs. Hinde. The specimen had been attacked, probably after death, by ants or other pests, and the scent-brands on the hind wings eaten away. The portion of the wing bearing the brands has been removed as neatly as if it had been cut out with scissors.

A fine series of 371 insects, chiefly Lepidoptera, but also including a few valuable accessions from other Orders, was presented by Herbert Druce, Esq., F.L.S., F.Z.S., &c. The localities were very numerous, the following parts of the world being represented :—North, Central and South America, East and West Africa, Japan, China, the Malay Archipelago, India.

Eighteen beetles of various groups from Asia Minor and

several European localities were presented by W. E. Sharp, Esq., F.E.S., together with 2 *Carabidae* from the Falkland Islands.

A valuable series of British insects of various Orders, of which 292 were catalogued, were presented by the captor, Major R. B. Robertson. The great majority of the specimens were taken at various dates in Hampshire, chiefly in the New Forest district, while a few were from Jersey, Wiltshire, Dorset and Cumberland. The collection including an interesting series of Hymenoptera Parasitica bred from Lepidopterous hosts, the names of which are recorded.

A series of 60 *Staphylinidae* from various British localities, and accompanied by full data, were presented by the captor, W. E. Sharp, Esq., F.E.S. The whole of the specimens were named by the donor, and all have been catalogued.

ADDITIONS TO THE COLLECTIONS IN 1907.

Several important accessions to both general and British collections have been catalogued and incorporated since the publication of the last Report. Of these, Dr. Longstaff's fine series from the New World, and Col. Verbury's splendid addition to the collection of British Diptera, have together occupied a large proportion of the time available for printing, labelling, &c.

The following are the total numbers of insects of all Orders catalogued from the collections made in the localities indicated (1906-7), and presented by Dr. G. B. Longstaff, D.M., F.R.C.P., New College. In addition to these, large numbers of uncatalogued specimens were also added to the Collections:—

Jamaica	.	.	.	729 specimens.
Barbados	.	.	.	42 "
Tobago	.	.	.	255 "
Trinidad	.	.	.	116 "
Panama	.	.	.	94 "
Colombia	.	.	.	77 "
Venezuela	.	.	.	431 "
Total				1744

This fine series, accompanied by the most excellent data, is a very welcome addition to the parts of the Collection from the tropical New World.

Fifty-two small Geometrid moths from the Khasia Hills, Assam (Nissary, about 1904), presented by Herbert Druce, Esq., F.L.S., were catalogued and incorporated after the publication of last year's Report, in which 1,427 moths from the Khasia Hills, presented by the same generous donor, were acknowledged.

A small set of 14 butterflies, greatly needed by the Department, was presented by C. A. Schunck, Esq. Six specimens were captured by E. Grauer (1905) in the interesting tract of country between the Albert Nyanza and Victoria Nyanza. The S. American examples included the rare *Heliconius clytia*, from British Guiana (Apr., 1907), a *Thyridia* (Rio, Mar., 1907), and a Hesperid (Buenos Ayres, Mar., 1907), all new to the Collections, and all captured by the donor.

Six butterflies and one moth, from Olokemeji Hill, near Lagos, about 800 feet (May, 1907, before the heavy rains), were presented by the captor, J. A. Cremer, Esq.

Nineteen Coleoptera and a Mantid, from various localities in South Africa (Natal, Cape Colony, Rhodesia), were presented by C. N. Barker, Esq., who has so often generously assisted the Department.

Thirty-three insects, chiefly moths, from the Potchefstroom cantonments (1904), were presented by the captor, Mr. E. E. Hamm.

Forty-five Lepidoptera, chiefly moths, and one Flatid (Homoptera), from Western Nigeria, were presented by W. H. C. Trousdell, Esq., B.A., Queen's College. The locality renders the specimens of much interest to the Department.

One hundred and three insects, chiefly butterflies, from Madagascar, were presented by the captor, Rev. J. U. Yonge, M.A., Keble College. The great majority were taken, in 1906-7, at Ambatoharanana (4,900 feet). The data are excellent, and the series a valuable addition to the University Collection which is in great need of specimens from Madagascar.

One hundred and eighty-seven Diptera from several localities in Portugal (1896), and Southern Spain (1901), from Hyères (1898) and the Tyrol (1896), were presented by the captor, Col. J. W. Yerbury. All the species have been determined by the donor, the data are full and exact, and the condition of the specimens extremely fine.

ADDITIONS TO THE BRITISH COLLECTIONS IN 1907.

A splendid collection of British Diptera was presented by the captor, Col. J. W. Yerbury, late R.A., F.L.S., F.E.S. No less than 2,795 specimens have been catalogued and incorporated. The species principally belong to the *Dolichopodidae*, and have been in part determined by Mr. G. H. Verrall, F.E.S., and in part by Col. Yerbury. All the determinations have been printed or written, and placed upon the specimens. The Scotch and English localities were very numerous, being scattered over the following counties, &c.:—Sutherland (1903-4), Haddington (1899), Perthshire (1898, 1904), Nairnshire (1904-5), Inverness (1898-1905), Caithness (1899), Elgin (1899-1905), N. Wales (1902), S. Wales (1906), Brecknock (1899-1902), Glamorganshire (1906), Herefordshire (1902-3), S. Devon (1898-1906), Dorset (1895-1907), Hampshire (1894-1907), Gloucestershire (1897-1906), Warwickshire (1901), Nottingham (1906), Hertfordshire (1899), Oxfordshire (1907), Cambridgeshire (1898-1903), Norfolk (1906), Suffolk (1901-7), Essex (1907), Surrey (1900-4), Kent (1906-7). In many cases specimens were captured in several localities in a single county.

In addition to this splendid accession to the Collection of British Diptera, Col. Yerbury also presented the following valuable series of British insects belonging to other Orders:—183 Hymenoptera Aculeata, all determined by Edward Saunders, Esq., F.R.S., 31 Hymenoptera of other groups, 24 Rhynchota, 18 Coleoptera, 5 Neuroptera, and 10 Orthoptera. The localities were the same as those in which Diptera were captured, but by far the largest numbers of other Orders were taken in Herefordshire.

The Report published last year contained an acknowledgment of a fine series of Coleoptera and Hemiptera, with full and precise data, presented by the captor, H. St. J. K. Donisthorpe, Esq., F.E.S. Since the date of publication another valuable set of British insects, presented by the same generous donor, has been labelled and catalogued. This series contains 278 Coleoptera, 44 Rhynchota, and 32 other insects belonging to the Diptera, Hymenoptera, Lepidoptera, Heterocera, Neuroptera, and Orthoptera (an example of *Periplaneta australasiae* from Kew). Several specimens are accompanied by the puparia from which they emerged. Many of the insects were associated with ants, having been captured in their nests or bred from observation nests. The collection also includes the example first found in Britain of the small spider *Thyreosthenius bivovata*. This interesting specimen was captured with *Formica rufa*, near Hastings (Apr. 1, 1900), by the donor. The localities were very varied and the data excellent.

A case of *Clythra*, together with the Parasitic Chalcids which had emerged from it, collected at Casays, N.W. Spain (3,500 ft.), in 1906 by Dr. T. A. Chapman, and a specimen of *Lomechusa strumosa*, captured at Courmayeur (5,000 ft.) by J. R. Tomlin, in August, 1906, were presented by H. St. J. K. Donisthorpe, Esq., F.E.S.

An Empid fly, together with the puparium from which it was bred (July 7, 1907), was presented by Mr. Joseph Collins, of the Hope Department. The puparium was found under rotten straw at Wood Eaton.

ADDITIONS TO THE COLLECTIONS IN 1908.

The additions to the collection of Orthoptera, especially *Blattidae*, due almost exclusively to the energy of Mr. R. Shelford, are acknowledged together at the beginning of the following section. A single important addition to the British collections is acknowledged at the end and not under a separate head.

The following series of *Blattidae* have been incorporated :—

Four specimens representing three species, of which one is

undescribed, presented by the Deutsches Entomologisches National-Museum, Berlin.

A set of 13 specimens, all new to the Collection, received in exchange from the British Museum. The series includes co-types of 6 species described by W. F. Kirby and of one species described by Brunner von Wattenwyl.

Forty-four specimens, presented by the Natural History Museum, Brussels.

Thirteen specimens from N.W. Borneo, presented by the Sarawak Museum, Borneo.

Thirty-three specimens, and one Forficulid, collected by Drs. Michaelsen and Hartmeyer in S.W. Australia, presented by the Hamburg Museum. The series includes co-types of the following species described by R. Shelford:—*Platyzosteria tibialis*, *Stylopyga michaelseni*, *Desmozosteria rufescens*, and *Ceratinoptera ensifera*, together with 7 other species new to the Collection.

Three specimens, together with one Phasmid, collected by W. L. Travers, Esq., F.L.S., at the Hot Lakes, North Island, New Zealand, presented by Commander J. J. Walker, Hon. M.A., F.L.S., F.E.S.

Ninety-four specimens from various localities, presented by the firm of Staudinger and Bang-Haas. The series includes 79 species, of which 48 are new to the Collection, and 20 new to science.

Seven specimens from Ceylon and the Malay Peninsula, and one taken on board ship in the Red Sea (all 1907-8), presented by the captor, Geoffrey Meade-Waldo, Esq., B.A., Magdalen College, of the Natural History Museum.

Twelve specimens, representing 11 species new to the Collection, purchased from H. Donckier de Donceel, presented by R. Shelford, Esq., M.A., F.L.S., F.E.S., Emmanuel College, Cambridge.

The following Orthoptera of groups other than *Blattidae* have been incorporated:—

Twelve Central-American *Phasmodae*, presented by Dr. F. D. Godman, Hon. D.C.L., F.R.S. The co-types of 6 species, described by Brunner von Wattenwyl, are included.

A valuable series of 225 Orthoptera of various groups (chiefly *Acridiidae*), collected in Selangor, Malay Peninsula, in 1907-8, presented by H. C. Pratt, Esq.

Three *Acridiidae* from Jerusalem (1898), presented by the captor, A. H. Swinton, Esq., F.E.S.

A fine collection of 2,147 insects of many Orders made (1907-8) by Dr. G. B. Longstaff in Ceylon, and 184 in India, has been worked out by the donor and labelled in the Department. It will be catalogued and incorporated at an early date, and fully acknowledged in the Report of next year.

A very fine set of 425 moths from the Khasia Hills, Assam (Nissary, about 1904), was presented by Herbert Druce, Esq., F.L.S., F.Z.S. This donation extends the splendid series of moths from the same locality acknowledged in previous Reports. As before, the condition of these delicate insects—many of them of minute size—is extremely fine.

One hundred and seventeen insects of various Orders chiefly Orthoptera, from the Botanic Gardens, Singapore (1908), and 37 from Kukub, S. W. Johor, Malay Peninsula (April, 1908), were presented by the captor, H. N. Ridley, Esq., M.A., Exeter College, F.R.S. The full and precise data render the collection of great value to the Department.

Forty-one Diptera, chiefly *Asilidae*, from Sikkim (April, 1891), were presented by the late Lieut.-Col. C. T. Bingham, F.Z.S., F.E.S.; together with a valuable series of 110 Hymenoptera Aculeata and 4 *Chrysididae*, collected in the same locality by F. A. Möller (April, May, 1902). All the species of Hymenoptera were determined by the donor.

Ten butterflies greatly needed by the Collections were presented by the captor, Commander J. J. Walker, Hon. M.A. The series includes 6 much-wanted *Pierinae*, 2 examples of the dry season form of *Precis almana* from Haining, E. China (Oct. 7, 1892), and a species of *Danaida* (*Salatura*) from N. W. Australia (1891).

Twelve *Asilidae*, from various localities in N. W. Borneo, were presented by the Sarawak Museum.

One Hemipteron and a Lycaenid butterfly from Muang

Praa, Upper Siam (probably 1898), were presented by Cyril Yates, Esq., B.A., Wadham College.

A valuable set of 20 butterflies from localities in W. China, close to the Thibetan boundary, was presented by H. Druce, Esq., F.L.S., F.Z.S., F.E.S. The geographical data are given with the utmost precision, and this, together with the exceptional interest of the localities themselves, renders the specimens of great value to the Collections.

Sixty-seven butterflies from the Tian Shan Mountains, W. Mongolia (about 1906), were purchased from H. Grose-Smith, Esq., F.E.S.

An extremely interesting series of butterflies of the Nymphaline genus *Neptis* from Madagascar and the surrounding islands was presented by Monsieur Charles Oberthür of Rennes who has, on previous occasions, given rare and valuable specimens to the University Collection. The species were *N. comororum* (two examples collected in the Comoro Islands by L. Humblot in 1885-6); *N. mayottensis* (collected in Mayotte Island by Humblot); *N. dumetorum* (Bourbon: Dr. Ronsel); *N. saclava* (Madagascar: E. Perrot, 1888). The specimens were exhibited to the Entomological Society in the course of a discussion on these island forms of the genus (*Proceedings*, 1908, pp. xxxiii-xlii).

A male and female specimen of the rare Lasiocampid moth, *Glocia clarki*, together with a preserved larva and a cocoon from the neighbourhood of Durban, were presented by the discoverer of the species, E. L. Clark, Esq., F.E.S. The specimens were exhibited to the Entomological Society of London (*Proceedings*, Nov. 4, 1908).

Seventy Longicorn beetles from the Ethiopian Region were presented by the Zoological Museum, Tring. This valuable series includes co-types of species described by Karl Jordan.

The fine and valuable series of butterflies from Rabai, near Mombasa, presented by the captor, Rev. K. St. A. Rogers, M.A., Wadham College, has not yet been incorporated although all specimens are labelled. The following have, however, been added to the Collection:—a beautiful example of the male

Euxanthe tiberius (Nov. 27, 1906), the *trophonius* female form of *Papilio dardanus*, rare at Rabai, a female of *Papilio phorcas* of a form slightly different from any in the Department. The two latter are undated. The *Euxanthe* was sent through the post and greatly damaged, but has been successfully repaired by Mr. Hamm.

A female example of *Planema poggei* from Entebbe (1904) was presented by H. Eltringham, Esq., F.E.S.

A very interesting series of 7 examples of *Charaxes neanthes* and 1 *C. zoolina*, bred in 1908 from eggs laid by a female *neanthes*, was purchased from Mr. G. F. Leigh. Thus the long suspected specific identity of these two forms is confirmed. The specimens, which are accompanied by full data, were exhibited to the Entomological Society (*Proceedings*, Oct. 21, 1908).

A valuable set of 136 Coleoptera from various localities in N. America were presented by Guy A. K. Marshall, Esq. The specimens, which possess excellent locality labels, were collected by E. B. Williamson, Esq.

Forty-seven butterflies from Omai, British Guiana, were presented by W. Schaus, Esq., F.E.S.

Three hundred and two Lepidoptera, chiefly butterflies, from various localities, principally Venezuela, were presented by H. Balfour, Esq., M.A., Trinity College. The specimens were contained in cabinets purchased for the Pitt-Rivers Museum. Some of the localities being obviously erroneous, it was considered safer not to catalogue any of the specimens as permanent accessions, but all have been provisionally added to the Collection.

A series of 117 bees from Argentina (1906-7) was purchased from the captor, A. C. J. Haarup. The species were determined by Friese and include co-types of 17 new forms described by this authority in "Die Apidae von Argentina," 1908. The specimens are accompanied by excellent data.

Twenty-three Diptera, chiefly *Asilidae*, and one *Erebia*, from the Porto de Pajares, Spain, 6,000 ft. (July, 1904), were presented by the captor, Dr. T. A. Chapman, F.E.S.

A fine set of 785 insects of several Orders, of which 470 have been catalogued, were presented by the captor, Dr. G. B. Longstaff. The specimens were captured at various localities in the neighbourhood of Morteheo, N. Devon, in 1896-8. All the data are precise and full. The Orders chiefly represented are the Hymenoptera, Diptera, Coleoptera, and Rhynchota. The series includes three interesting examples of Asilid flies captured with their prey (in every case Dipterous).

The additions to the bionomic collections during 1908 were very interesting and extensive, but the specimens have not yet received their printed labels. Mention must, however, be made of the fine series of over 600 specimens presented by Mr. A. H. Hamm and of about 50 presented by his son, C. H. Hamm. The whole of the bionomic material will be acknowledged in detail in next year's report.

THE HOPE LIBRARY.

With Miss Shelford's assistance great progress was made with the card catalogue in the course of the year. The Lepidoptera, one of the most important sections of the Library, were completed, the cards in the general section revised and rearranged, and the numerous accessions catalogued.

DONATIONS.

The following publications and Reports were presented :—
Bombay Natural History Society: Journal, vol. xviii, pts. 1-3.

Boston Society of Natural History: Proceedings, vol. xxxiii (1907).

British Museum, Trustees of the:—

F. V. Theobald, M.A.: A Monograph of the Culicidae of the World, vol. iv.

C. O. Waterhouse: A Guide to the Exhibited Series of Insects.

Cambridge University: Forty-second Annual Report for 1907 of the Museum and Lecture-rooms Syndicate.

Carnegie Institution of Washington, Department of Marine Biology: Directors' Annual Report for 1907.

- Cornell University Library : Librarian's Report, 1906-7.
- India Office, Secretary of State for India in Council :—
 The Fauna of British India, including Ceylon and Burma.
 W. L. Distant, Rhynchota, vol. iv (Homoptera), Part II
 and Appendix.
 M. Jacoby : Coleoptera, vol. i, Chrysomelidae.
- Indian Museum, Calcutta : Report for 1906-7.
 Records, vol. i, 1907 ; vol. ii, pt. 1. Memoirs, vol. i, 1907.
 Report of the Conference as regards Museums in India,
 1907.
- Indiana University : Bulletin, vol. i, no. 4.
- Ireland, Dept. of Agriculture and Technical Instruction :
 Index to the Scientific Publications, by C. Green, B.A.
 Second Report on the Copepoda of the Irish Atlantic
 Slope, by G. P. Farran, B.A.
- Michigan Academy of Science : Report, 1907.
- New York State Museum : Fifty-ninth Annual Report.
- Ottawa Experimental Farms : Report 1906, and evidence
 of progress of agriculture in 1906-7.
- Owens College : Report of the Manchester Museum,
 1907-8.
- President's Address. Trans. R. Soc. Canada, i, 3rd ser.,
 1907-8.
 Bulletins : Nos. 57, 1907 ; 59, 60, 1908.
- Radcliffe Library : Catalogue of Books added to the Library
 in 1907.
- Smithsonian Institution, Washington : Memoirs on Insects
 and Crustacea by the following authors :—A. Busck,
 A. N. Caudell, J. A. Cushman, H. G. Dyar, H. J.
 Franklin, F. Knab, W. D. Kearfott, A. S. Pearse,
 W. Dwight Pierce, A. E. Ortmann, M. J. Rathbun,
 Harriet Richardson, J. A. G. Rehn, E. Saunders,
 W. Schaus, J. B. Smith, T. R. R. Stebbing, W. Warren,
 C. B. Wilson, E. B. Williamson.
- Swedish Academy of Science : Vetenskapsakademien's
 Årsbok, 1907.

United States, Department of Agriculture: Bureau of Entomology, Washington; Thirty-one bulletins on Economic Entomology by various authors; one monthly list of Publications issued by the Department; Circular 76 (revised to March 1, 1908).

United States National Museum, Washington: Annual Report for 1906-7.

The following authors have presented their publications to the Library:—

Dr. Nicolai von Adelung, of St. Petersburg Museum: Five memoirs on Orthoptera (three in Russian), and two Biographical Notices.

Prof. C. Aurivillius, of Stockholm Museum: Six memoirs on Coleoptera.

G. T. Bethune-Baker, F.L.S., F.Z.S., F.E.S.: Three memoirs on Lepidoptera.

Prof. Mario Bezzi, of Turin: Five memoirs on Diptera, and an obituary notice of C. Rondani.

J. Bourgeois: Coleoptera,—Malacodermata of Sjostedt's Kilimandjaro-Meru Expedition, 1905-6.

Dr. A. G. Böving, of Copenhagen Museum: Bidrag til Kundskaben om Donaciin-Larvernes Naturhistorie.

Lawrence Bruner, Professor of Entomology and Ornithology in the University of Nebraska, U.S.A.: Six treatises on Orthoptera.

Malcolm Burr, B.A., F.E.S., F.L.S., F.Z.S.: Nine memoirs on Orthoptera.

Dr. Achille Griffini, of Genoa: Nine treatises on Orthoptera.

Dr. H. Karny, of Vienna: Five memoirs on Orthoptera.

Dr. Sheffield Neave: Portions of Report on Work of Katanga Medical Commission, 1906, 1907, 1908, with map.

Roland Thaxter: A contribution toward a Monograph of the Laboulbeniaceae. Part II. This monograph was transferred to the Botanical Department of the University, where the first part had been deposited.

Dr. Franz Werner, of Vienna University: Seven treatises on Orthoptera; one treatise on Arachnida.

Valuable additions to the Library have been presented by the following donors :—

Vicomte R. du Buysson of Paris Museum : Catalogue of Forficulidae in the Paris Museum, by Malcolm Burr.

Csiki Ernő, Curator of the Hungarian Museum : three papers on Orthoptera, by D. Kuthy.

The late Sir John Evans, K.C.B., Hon. D.C.L., F.R.S.: Memoirs and Records of Science from the Bologna Institute.

Dr. F. D. Godman, Hon. D.C.L., F.R.S., &c.: *Biologia Centrali-Americana, Hemiptera-Homoptera*, 6 parts, by W. L. Distant and Rev. Canon W. W. Fowler.

Dr. G. B. Longstaff, D.M., New College, F.R.C.P., F.E.S.: *The Natural History of British Insects* by E. Donovan, Vols. I–XVI. A beautiful example of this rare and costly publication. *The Life-History of House-flies*, by A. Griffith. *Papers on Arthropoda*, by V. Lienard and F. Plateau.

G. A. K. Marshall, F.Z.S., F.E.S., &c.: Three papers on Coleoptera in “*Genera Insectorum*,” by A. Bovie.

Prof. R. Meldola, F.R.S.: “*Entomological Tracts*,” by H. W. Bates and A. G. Butler. Bound volumes of papers of considerable historic interest as well as great scientific value.

Prof. E. B. Poulton, F.R.S., &c.: “*Linnéporträtt. vid Uppsala Universitets Minnefest på Tvåhundraårsdagen af Carl von Linnés födelse*,” by Tycho Tullberg. One paper on Lepidoptera collected by W. J. Burchell. Lancashire and Cheshire Entomological Society Report and Proceedings, Vol. XXX, 1906, Vol XXXI, 1907.

Hon. Walter Rothschild : *Novitates Zoologicae*, Vol. XIV, Part 3.

R. Shelford, Esq., M.A., F.L.S.: Several treatises on Arachnida by various authors. Treatises on Crustacea, by E. Simon. Myriopoda, by Professor F. Silvestri.

Dr. Henry Skinner, M.D.: “*Entomological News*,” containing various papers, Vol. XVII. 10.

Colonel J. W. Yerbury : *A List of British Diptera*, Parts I–III (1888), by G. H. Verrall. Asilidae from Aden and its neighbourhood, by F. M. Van der Wulp.

The publications of the Société Entomologique de France for 1908, and of the Société Entomologique de Belgique for 1908, the publications of the Linnean Society for 1908, the Transactions of the Entomological Society of London for 1907 and 1908, and the Proceedings of the Association of Economic Biologists, vol. i, Part IV, were presented by the Professor.

Original papers have been presented by the following authors :—Dr. F. A. Bather; Professor T. Hudson Beare, F.R.S.E., F.E.S. (three memoirs); H. Boileau; Dr. L. Bordas (four memoirs); Charles T. Brues (two memoirs); Vicomte R. du Buysson; Dr. A. N. Caudell (nine memoirs); Professor T. D. A. Cockerell (four memoirs); N. A. Conte in conjunction with M. L. Faucheron; Ernö Csiki, Curator of the Hungarian National Museum; H. Hamilton Druce, F.L.S.; Herbert Druce, F.L.S. (three memoirs); H. Donisthorpe; Professor F. Y. Edgeworth, All Souls College, Oxford; Dr. Günther Enderlein of Stettin; Dr. R. Gestro, of the Genoa Museum; Dr. L. O. Howard; Professor Dr. F. Hermann, of Erlangen; A. D. Imms, M.Sc. Birmingham, B.Sc. Lond., of Allahabad University; Dr. G. B. Longstaff, D.M., &c. (two memoirs); J. Mangan; G. A. K. Marshall, F.Z.S. (three memoirs); W. S. Marshall; Dr. G. W. Peckham and Mrs. Peckham; Rev. O. Pickard-Cambridge, M.A., F.R.S.; Dr. J. A. G. Rehn (ten memoirs, one in conjunction with Morgan Hebard); Edward Saunders, F.R.S.; C. Schaeffer; Dr. A. Schulthess-Schindler, of Zürich; Professor O. M. Reuter, of Helsingfors; Hugh Scott, B.A.; R. Shelford, M.A., F.L.S. (eight memoirs); Dr. V. E. Shelford, of Chicago University (two memoirs); A. E. Shipley, M.A., F.R.S., Hon. D.Sc., Princeton; Dr. Y. Sjöstedt, of Stockholm Museum; M. V. Slingerland; Rev. T. R. R. Stebbing, M.A., F.R.S., F.L.S. (four memoirs); T. H. Taylor, M.A., of Yorkshire College, Leeds (three memoirs); E. L. Trouessart; J. G. O. Tepper, of Adelaide Museum; Rowland E. Turner, F.E.S. (six memoirs); S. E. Weber; Professor W. M. Wheeler, of Harvard University; Wm. Williamson.

EXCHANGES.

The following were received in exchange for the Hope Reports:—

American Entomological Society, Philadelphia, Transactions, vols. xxxi, xxxii (1905, 1906).

Deutsche Entomologische Zeitschrift for 1907.

Entomologisk Tidskrift, Stockholm, vol. xxviii (1907).

Bulletin de la Société Entomologique Suisse, vol. xi, pts. 7, 8.

Naturalist's Miscellany, vol. vi, from A. H. Hamm.

PURCHASES.

The following publications of the year 1907 were purchased for the Department:—The Ray Society volume, the volume of the Zoological Record, the numbers of the Entomologist's Monthly Magazine, the Entomologist, and the Entomologist's Record.

In addition to the above—the normal expenditure for many years—the following purchases were made:—

The Ichneumons of Great Britain, vol. i, Ichneumoninae; vol. ii, Pimplinae, by Claude Morley.

Die Insektenfamilie der Phasmiden. Vol. iii. Phasmidae Anareolatae. By K. Brunner v. Wattenwyl and Jos. Redtenbacher.

Die Apidae (Blumenwespen) von Argentina nach den Reisenergebnissen der Herren A. C. Jensen-Haarup und P. Jörgensen in den Jahren 1904-7. By H. Friese.

And fourteen treatises on Orthoptera by the following authors:—P. Biolley, Ignacio Bolivar, Auguste de Bormans, Achille Raffray, Henri de Saussure and J. Portschinsky, Dr. H. A. Krauss, A. Pictet, A. Finot, J. D. Alfken, A. Gerstaecker, R. P. Longinos Navás.

One treatise on Lepidoptera by E. Bugnion.

One treatise on Coleoptera by Dr. Stierlin.

A Natural History of the British Lepidoptera, vol. ix, by J. W. Tutt.

E. B. POULTON.

Report of the Hope Professor of Zoology, 1909.

It will be realized from the following pages that the year 1909 has been marked in the history of the Department by rapid growth of the collections, by the large amount of work that has been done, and by generous assistance of many kinds that has been rendered.

The urgent necessity for increased space to which attention has been directed on many occasions is at length to be met by extension into the southern end of the old Radcliffe Library.

1. *Financial Gifts and Grants to the Department.*

For many years the expense of an extra assistant has been generously defrayed by Dr. G. B. Longstaff. In 1909, by the munificent gift of £2,400, Dr. Longstaff created an endowment which renders the assistantship permanent or can be employed to aid the Department in other directions. The Trust deed is a model one in its simplicity and the provision to ensure that, whatever the conditions of the future, the fund will always be of the highest utility to the Department.

The dangerous state of the collection of moths has been referred to in earlier Reports. This great collection, containing hundreds of types, was either far too densely crowded in cabinets of an old and unsafe kind or kept in the original store-boxes of the W. W. Saunders collection (1830-1873), in which they were purchased and presented by Mrs. F. W. Hope in 1873. The boxes themselves were well made by the celebrated cabinet-maker Standish, but they are so old that the cork has lost much of its elasticity and large insects are very liable to fall, injuring themselves and others. Small and delicate insects are in even greater danger from the rush of air caused by opening so large a box. These great risks have been averted during the past year, and the whole collection of moths is now safely arranged in a series of interchangeable drawers, sufficiently numerous to admit of increase for many years. The large Van der Poll collection, recently disposed of in London, was in chief part contained in 960 drawers fitting into 5 enormous cases without doors. These

were purchased for £250, and transferred for alteration and improvement to Messrs. Hill, the cabinet-makers of Willesden. Here all the drawers were repapered and provided with camphor-cells and label-holders, while the unwieldy cases were cut up into 20 cabinets each holding 48 drawers. Doors were fixed and one plinth was provided for every pair of cabinets. All these cabinets, now safely transferred to Oxford, are devoted to the General Collection of moths and its increase in the future. The cost of conversion and carriage amounted to about £150, the total cost to about £400. Of this sum part was provided by the generous donation of £185 made by Brasenose College, and £165 from the Fellowship granted for University purposes to the Professor by Jesus College. The Department is deeply indebted to the patriotism of these two Colleges and Magdalen College, which by its grant has made possible so much good work upon the collections of Orthoptera.

An entire rearrangement of the whole of the cabinets was effected sixteen years ago when the Department was enlarged in 1894. Another such rearrangement is now greatly needed, and advantage will be taken of the extension into the south end of the old Radcliffe Library in order to bring it about. At this time extra cabinet accommodation, especially for the rapidly growing and largely studied collection of butterflies, will be very much wanted; for by arranging cabinet sections of empty drawers in proximity to the most rapidly growing parts of the series, the benefits of re-classification can be made to endure for a much longer time. The need will be largely met by £300 granted for this purpose in 1910 and £300 in 1911, by the Common University Fund. If it were possible, during the present year, to order a still further supply, there is no doubt that increased efficiency would be secured, and the expenditure of considerable unnecessary labour in the future avoided. It is hoped that it may be possible for one or more Colleges to give to the Department, at this critical point in its history, the help that has been generously granted by Jesus, Magdalen, and Brasenose Colleges.

A valuable gift of cabinets containing 138 drawers by the Hon. Walter Rothschild is especially opportune. The cases

require some repair, but the drawers themselves are in excellent condition and, being deep, will accommodate continental specimens as well as those prepared in the old British style.

2. *The F. P. Pascoe Collections and Library.*

The chief collections containing over 3,000 types of the late Mr. F. P. Pascoe, F.L.S., F.E.S., the distinguished authority on certain important groups of Coleoptera, were acquired by the British Museum of Natural History in 1893. Mr. Pascoe was, however, a naturalist of the widest interests, and in the course of his numerous journeys assiduously collected all classes of animals. Owing to the kind suggestion of Dr. A. R. Wallace, Hon. D.C.L., all the remaining collections were generously presented to the University by Miss Pascoe, together with the zoological portions of her father's library. The numerous cabinets and cases, together with large numbers of books and hundreds of memoirs, were safely conveyed by road from London by Messrs. Archer & Co. An account of the Library will be found towards the end of this Report (p. 43). Some of the cabinets and cases with the specimens therein contained were transferred to Professor G. C. Bourne's Department; but the great majority, occupying 13 cabinets, belong to the Arthropoda and are appropriately placed with the Hope Collections.

3. *The Lepidoptera of Teneriffe.*

The study of island faunas is of peculiar interest; and the University is greatly indebted to Mr. W. Walmesley White of Güimar, Teneriffe, who has generously presented his very fine collection of butterflies and moths of the island. The collection will be kept separate so that it can be studied as a whole. It is a welcome addition to the Wollaston collection of beetles from Madeira, purchased and presented in 1861 by Rev. F. W. Hope, and from the Canary Islands, presented in 1865 by Mrs. F. W. Hope.

The Walmesley White Collection contains over 200 butterflies and over 550 moths, the latter including the type of *Hadena whitei* of Rebel. The donor continues to take great interest in improving and completing the collection. In working out the larger moths much kind assistance was

rendered by Dr. Rebel, and in the Micro-Lepidoptera by Lord Walsingham and Mr. J. Hartley Durrant.

The larger specimens have been reset, and the smaller ones staged in the Department.

4. *The Prout-Bacot Mendelian breeding Experiment on Acidalia virgularia.*

The authors of this important investigation, Mr. L. B. Prout, F.E.S., and Mr. A. Bacot, F.E.S., have presented the whole of the material to the Hope Department, where it can be studied by all who are interested in the problems of heredity. The material consists of between 5,000 and 6,000 specimens bred in ten generations from a cross between two geographical races of the moth—the one a dark form from the London district, the other white, from the south of France.

The results, which “were entirely negative so far as Mendelian segregation is concerned,” are recorded in the Proceedings of the Royal Society (B. Vol. 81 (1909), p. 133).

Mimetic Butterflies from a patch of tropical Forest near Entebbe.

Although it has not been possible to catalogue these specimens, captured and presented by Mr. C. A. Wiggins, F.E.S., in 1909, special mention must be made of them in this Report. The captures of *Danainae* and *Acraeinae* in this limited area, together with their Nymphaline and Papilionine models taken on the same day, will, there is little doubt, throw very much light on the problem of mimicry.

5. *The Sellon Collection of British Lepidoptera.*

This fine collection, made by Mr. H. S. Sellon, was presented by the mother and sisters of the late naturalist. It is contained in three cabinets, which were safely transferred by road with the Pascoe Collection. It is intended to place the rarest specimens, after careful labelling, in the Hope Collection in the Department, and to make the remainder available for the study of the public. It is hoped by this means to help in stimulating a general interest in the subject to which Mr. Sellon was so deeply devoted.

6. *The A. F. Chitty Collection.*

This important collection, presented by Mrs. Chitty, was acknowledged in the Report of last year, but at the time of the transference in 1908, a case of recently collected specimens was overlooked. Advantage was taken of the carriage of the Pascoe Collection to bring these specimens safely to Oxford.

7. *Work done by the Staff.*

The most important single piece of work undertaken by Mr. W. Holland was the arrangement in six 20-drawer cabinets of the general collection of *Hesperiidae* ("Skippers"), after the list prepared by Dr. G. B. Longstaff (see p. 9) in the British Museum of Natural History. Thus arranged the collection of *Hesperiidae* will be of the greatest value. The whole of the butterflies are now named and classified, but the Oriental and African Papilios still require to be placed in the uniform Department cabinets with interchangeable drawers. As the collection grows fresh rearrangements are of course required from time to time. Thus during 1909 Mr. Holland helped Mr. S. A. Neave (see p. 10) to carry out an entire rearrangement of the *Acracinae*, in five 20-drawer cabinets. He also spent much time in assisting Mr. Neave in work upon his great Rhodesian Collection.

Mr. Holland continued and completed the provisional arrangement of the Coleopterous groups, bringing together into eight or nine old cabinets the scattered material of thirty-three of the smaller families, sub-families, &c. A still larger piece of work, begun in 1909 and now completed, was the arrangement, in fourteen 48-drawer cabinets, of the General Collection of moths, which had been scattered through many kinds of cabinets and in large part dangerously crowded in very old drawers, and in even greater danger in the old store-boxes of the W. W. Saunders Collection (see p. 1). Ten families of moths were thus transferred and rendered safe in 1909, some of them (viz. the *Castniidae*, *Saturniidae*, *Cossidae*, &c.) containing large insects occupying much space. The arrangement of the *Sphingidae*, after Rothschild and Jordan's great monograph, was begun in 1909, but the chief part of this work fell into the present year.

Mr. Holland also completed the examination, begun in 1908,

of the whole of the cabinets, with the object of supplying fresh naphthaline wherever it was needed. He spent much time in the early part of the year in tabulating the localities of specimens in the Pascoe Collection, adding naphthaline as the work proceeded. The yearly work of incorporating the labelled and catalogued accessions has also been heavy in 1909.

Mr. A. H. Hamm has been chiefly occupied during the year with the great collections of insects presented by Mr. S. A. Neave, Dr. G. B. Longstaff, and Mr. C. A. Wiggins. Advantage was taken of the presence of Mr. Neave in this country to finish the manipulation and labelling of as many of his specimens as possible. Mr. Neave was thus assisted in his work on the collections, while at the same time many difficulties were removed that might have been pressing in his absence. Mr. Hamm also spent a considerable amount of time upon the collection of *Pierinae*, repinning a large number of specimens to show the under surface and making other changes desired by Dr. Dixey. Another great piece of work was the incorporation of the very fine series of British Diptera presented by Colonel J. W. Yerbury.

The old specimens in the historic Dale Collection were in a very unsafe condition, being so low on their pins as to be in contact with the bottom of the drawer. Much of Mr. Joseph Collins's time has been employed in staging these specimens and rendering them quite safe. The most delicate insects, the minute moths, were first put right: after these the Diptera and the parasitic Hymenoptera. The specimens of certain groups of the Miers Collection were given full printed labels so that they can be incorporated in the General Collection without losing their identity. The additions to the collections acknowledged in the later pages of this Report sufficiently indicate the large amount of labelling undertaken by Mr. Collins. Printed and written determinations have also been affixed to large numbers of specimens, including the very fine series of British Diptera presented by Colonel Yerbury, and of British Coleoptera presented by Mr. H. St. J. K. Donisthorpe. Mr. Collins also assisted Mr. Hamm in labelling the collections presented by Mr. Neave and Dr. Longstaff.

8. *Work on the Collections of Orthoptera.*

Owing to Mr. R. Shelford's protracted illness work on the collections of Orthoptera was much interrupted. The arrangement of the *Phasmidae* was completed and the collection now occupies 90 drawers. The following sub-families of *Locustidae* have been arranged:—*Stenopelmatinae*, *Gryllacrinae*, *Saginae*, *Callimeninae*, *Ephippigerinae*, and *Decticinae* (in part). Dr. A. Griffini, of the R. Istituto Tecnico, Bologna, rendered the most generous and valuable assistance in determining the *Gryllacrinae*. The bulk of the collection, including some of Francis Walker's types, were sent to Dr. Griffini, and three memoirs have issued from his pen as a result of his study of these specimens. A small supplementary collection of *Tetriginae* (Fam. *Acridiidae*) was sent for determination to the well-known authority on this group, Dr. J. L. Hancock, of Chicago, and will be further noticed in next year's Report. The *Blattidae* collected by Drs. Michaelsen and Hartmeyer in S.W. Australia, by Dr. Sheffield Neave in the Congo basin, and the *Blattidae*, *Mantidae* and *Phasmidae* collected by Dr. Rivet in Peru, were determined during the course of the year and co-types of most of the new species and many much-desired duplicates of known species have been deposited in the Hope Collections. By far the most important accession during the year is the Van der Poll collection of Orthoptera, purchased from Mr. O. E. Janson, and presented by the Professor. This collection comprised a great number of *Phasmidae*, and the incorporation of these specimens in the Hope Museum series occupied most of the autumn months. Owing to this valuable addition the Hope Collection of *Phasmidae* is now one of the largest in Europe, and certainly one of the most important, containing as it does so many of Westwood's types, all of H. W. Bates's types, and a few of Serville's and Gray's. The Van der Poll collection also included a fine series of *Locustidae*, which still await incorporation, many fine *Mantidae*, and a few *Blattidae* and *Acridiidae*. The memoirs on the family *Blattidae* and other Orthoptera, published during the course of the year 1909, will be found in Section 14 (pp. 11–15).

During his enforced absence from the Department Mr. Shelford was able to carry out a very valuable and laborious piece of work in the preparation of manuscript generic and specific indices for the 442 genera and 2,244 species of *Hesperidae* recorded in Dr. G. B. Longstaff's manuscript list (see Section 12).

9. *Work on the Collection of Pierinae.*

Dr. F. A. Dixey has been chiefly engaged in incorporating fresh material in the general collection of *Pierinae*. A large number of specimens has been dealt with, especially those collected by Dr. G. B. Longstaff in Ceylon, and the Rev. K. St. Aubyn Rogers in British East Africa. The excellent data accompanying the specimens sent home by these collectors make their addition to the series extremely valuable. Particular attention has been given to the genera *Pinacopteryx* and *Terias*. The Hope Collection has for some time past been accumulating material which will greatly facilitate the future elucidation of these difficult groups, a work which is much needed. Dr. Dixey also in the course of the year so far completed his investigation of the scent-distributing structures of the *Pierinae* as to make it possible to publish the chief results of his observations. These have been recorded in the Presidential Address delivered by him to the Entomological Society of London in the present year.

10. *Rearrangement of the British Beetles.*

Commander J. J. Walker has continued to give the kindest help in this great work. The *Buprestidae* and *Elatерidae* have been completed, and the *Staphylinidae*, begun in 1909. The valuable results of Commander Walker's labours will appear in the Report of next year, when the final arrangement of the British *Carabidae*, completed in the present year, will be described, and the remainder of Mr. W. Holland's splendid gift of British beetles of this group acknowledged. It is possible that other groups also will be arranged within the present year.

11. *Work upon the Burchell Collections.*

The two papers published by Mr. J. C. Moulton, Magdalen College, early in 1909 (see p. 15), completed the account of

Burchell's South American *Nymphalinae*. Since the author's departure to Borneo the work has been continued by Mr. E. G. Joseph, Lincoln College, who finished his description of the *Heliconiinae* before the end of the year. There was some delay in publication, and the memoir did not appear until the number of the *Ann. Mag. Nat. Hist.* for April, 1910 (p. 322). One hundred and sixty Burchell specimens, belonging to this sub-family, were found in the cabinets, and their investigation has produced one of the most interesting of the memoirs upon the collections of the great naturalist.

12. *Assistance in Working out the Material of the Department.*

By the lamented death of Mr. Edward Saunders, F.R.S., the Department has lost one of its kindest friends. The great English Hymenopterist was bound by special ties to the Museum, which possesses the large collections made by his father and cousin. His prompt and most efficient help will be sadly missed.

Dr. G. B. Longstaff, in addition to the munificent endowment mentioned on p. 1, and the specimens referred to towards the end of this Report, has given much time and labour to the Department, not only in working out the collections he has made, but also in carefully copying from the drawers of the British Museum a list of 2,244 species and 442 genera of *Hesperidae*. This list, with its indices prepared by Mr. R. Shelford (see Section 8), is now bound, and forms a large volume which is of the utmost value wherever this important group of butterflies requires to be studied.

Dr. Karl Jordan, on one of his visits to the Department, very kindly looked through the collections of American and Oriental *Papilioninae*, which had been arranged in accordance with the two great monographs in the *Novitates Zoologicae*. A few errors were thus detected and set right. On another visit he similarly confirmed or corrected the determinations in the Nymphaline group *Charaxes*. Large numbers of moths and of African Longicorn beetles, previously taken to Tring, were returned in the course of 1909 with determinations by Dr. Jordan or Mr. Warren.

Mr. Roland Trimen, F.R.S., has frequently visited the Department, and has rendered much kind assistance in the study of African butterflies.

During residence in Oxford in 1909 Mr. S. A. Neave not only studied his own collection with a view to his memoir for the Zoological Society, but also gave much valuable help to the Department by classifying the *Acracinae*. In the course of this work he made the remarkable discovery that a transparent tropical East African butterfly, long known as *Acraea crystallina* of H. Grose-Smith, is the female of *A. chilo* of Godman (Ent. Monthly Mag., 1909, p. 171).

A discovery of equal interest was made by Mr. Harry Eltringham, who in the course of his researches upon mimicry in African butterflies found that an *Acraea* hitherto known as *A. aurivillii*, Staud., is the female of the eastern form of the common *A. alciope*. Much kind help was afforded by Dr. K. Jordan in the successful attempt to clear up the considerable confusion in which this problem was involved (Proc. Ent. Soc., Lond., 1909, p. 13).

Very kind help has been received as in previous years from Mr. Hamilton Druce in determining species of *Lycaenidae* and *Hesperidae*, and from members of the staff of the British Museum of Natural History in their respective groups.

Mr. T. Bainbrigge Fletcher has examined and named the Pterophorina ("Plume-moths") and described a new genus and species (see p. 14). Mr. W. J. Kaye rendered kind assistance with the South American butterflies, Mr. W. J. Lucas with the British Neuroptera. Dr. Achille Griffini's kind help is acknowledged in sections 8 and 14.

13. Visits of Naturalists.

It was impossible to arrange for the visit of the Council of the Entomological Society at the usual time towards the beginning of July. It is hoped, however, that there will be a large gathering in the present year.

The Department has in the course of 1909 been visited by the following naturalists who have contributed to the collections at various times:—Dr. Malcolm Burr, D.Sc., M.A., F.E.S.,

F.G.S., New College; Mr. T. Bainbrigge Fletcher, late R.N., F.E.S.; Mr. W. J. Kaye, F.E.S.; Mr. W. J. Lucas, B.A., F.E.S.; Mr. Guy A. K. Marshall, F.Z.S., F.E.S.; Professor R. Meldola, F.R.S., F.E.S., F.C.S., &c.; Mr. C. Mellows, Brasenose College; Mr. S. A. Neave, M.A., B.Sc., F.E.S., Magdalen College; Mr. Rowland E. Turner, F.E.S.; and Mr. W. Walmesley White.

The Department has also been visited by Professor Svante Arrhenius, of Stockholm; Professor J. M. Baldwin, Hon. D.Sc.; Dr. T. Balle, Director of the Imp. and Roy. Agric. Station, Götz, Austria; Professor J. F. van Bemmelen, of Groningen, Holland; Dr. Bíró-Lajos, Hon. Conservator of the Hungarian National Museum, Budapest; Mr. W. E. Darwin; Mr. H. Willoughby Ellis, F.E.S.; Professor J. Cossar Ewart, F.R.S., of Edinburgh; Dr. E. P. Felt, of the State Museum, Albany, N.Y., U.S.A.; Professor Walter Garstang, M.A., Jesus College, of Leeds University; Sir E. Ray Lankester, M.A., Hon. D.Sc., F.R.S., &c.; Colonel D. Prain, F.R.S., Director of the Kew Gardens; Professor R. C. Punnett, of Cambridge; Dr. P. L. Sclater, M.A., Hon. D.Sc., F.R.S., &c., Corpus Christi College; Mr. Hugh Scott, Curator of the Zoological Museum, Cambridge; Dr. G. Severin, Director of the Natural History Museum, Brussels; and Sir Everard im Thurn, M.A., Exeter College.

14. *Works published in 1909.*

The following papers by workers in the Hope Department, or upon its material, have appeared during the year 1909:—

I. From the Transactions of the Entomological Society of London, 1909:—

Page 253. Studies of the *Blattidae*.

X. A revision of the Old-World *Blattinae* belonging to the *POLYZOSTERIA* group, by R. Shelford, F.L.S., F.Z.S., F.E.S.

P. 329. Birds as a Factor in the Production of Mimetic Resemblances among Butterflies, by Guy A. K. Marshall, F.Z.S., F.E.S. Although only a small proportion of the whole, the Oxford material and records are incorporated

in this important paper, which deals with a subject often treated of in publications that have issued from Oxford. By Mr. Marshall's courtesy it will be included in a future volume of Hope Reports.

P. 471. An account of some Experiments on the Edibility of certain Lepidopterous Larvae, by Harry Eltringham, M.A., F.Z.S., F.E.S.

P. 509. Two remarkable forms of Mantid oothecae, by R. Shelford.

II. The following short papers, or brief descriptions of the material of the Department exhibited at the meetings of the Entomological Society of London in 1909, have been published in the Proceedings:—

March 3, p. vi. A Mëndelian experiment on *Acidalia virgularia*, by L. B. Prout, F.E.S., and A. Bacot, F.E.S., an exhibition of the extensive material presented by the authors to the Hope Department (see p. 4).

April 7, p. xviii. An exhibition of mimetic Oriental *Blattidae* and their Coleopterous models, by R. Shelford.

April 7, p. xx. On Reciprocal Mimicry, by G. A. K. Marshall, a continuation of the discussion on the Müllerian theory.

May 5, p. xxii. The Oestrid fly of the Rhinoceros, by S. A. Neave, M.A., B.Sc., F.E.S., Magdalen College.

May 5, p. xxv. The forms of *Danaida chrysippus* from Egypt and the Sudán (Jan.–Feb., 1909), by G. B. Longstaff, D.M., F.R.C.P., F.E.S., New College.

June 2, p. xxxii. A migration of Ladybirds observed 40 miles above Khartûm (Feb. 16, 1909), by Dr. G. B. Longstaff.

June 2, p. xxxiii. An Arabian species of *Scarabacus* (*S. compressicornis*) taken in Egypt, near the Sphinx, by Dr. G. B. Longstaff.

June 2, p. xxxiii. Exhibition of a carved Egyptian scarab from Upper Egypt, by the Professor. The scarab had been presented by Dr. Longstaff.

June 2, p. xxxiii. Exhibition of species of two genera of *Coccinellidae* captured *in coitu*, by the Professor. The species

were *Adalia obliterata* and *Halysia 18-guttata*, beaten out of a fir-tree at Tubney by Joseph Collins of the Hope Department (Aug. 5, 1908).

June 2, p. xxxiv. Exhibition of Diptera from Oxford and the New Forest, bred or captured by A. H. Hamm, of the Hope Department, by the Professor.

June 2, p. xxxiv. Exhibition of *Castnia thearapon*, a rare moth bred from a S. American orchid and captured by Dr. A. R. Wallace in his orchid-house at Broadstone, Dorset, by the Professor. Further details of this interesting record will be found on p. 28.

June 2, p. xxxv. *Eurytela hiarbas* (Drury, 1782), a probable form of *E. dryope* (Cramer, 1775), by the Professor. Fresh evidence by G. F. Leigh, F.E.S., of the two forms being observed *in coitu*.

June 2, p. xxxvi. Remarkable breeding experiment conducted by Rev. K. St. Aubyn Rogers on *Hypolimnas misippus*, by the Professor. Some account of the results will be found on p. 26.

June 2, p. xxxvii. Müllerian mimicry in *Euplocina*, by the Professor.

June 2, p. xxxviii. Small moths captured at sea, probably 190 miles from the land they had left, by the Professor. An exhibition of specimens collected by, and publication of observations made by F. Muir, F.E.S., and J. C. Kershaw, F.E.S. See also p. 29.

June 2, p. xl. F. Muir's and J. C. Kershaw's notes on the life-history of *Aulacodes simplicialis*, by the Professor. See also p. 29.

June 2, p. xlv. The use of the saw by a sawfly during oviposition, by the Professor.

Oct. 6, p. xlix. 15 *Charaxes neanthes* and 6 *C. zoolina* bred from eggs laid by a *zoolina* female, by G. F. Leigh, F.E.S. See also p. 28.

Nov. 3, p. lxiii. Three species of *Planema* (*Acraeinae*) and their Nymphaline (*Pseudacraea*) and Papilionine mimics taken on a single day (July 11, 1909) by C. A. Wiggins, F.E.S., by the Professor.

Nov. 17, p. lxvii. Mimetic relations of certain East and West African butterflies, by Harry Eltringham.

Nov. 17, p. lxi. Probable mimetic association of Aculeate Hymenoptera captured on the flowers of a single tree, near Jericho, by Rev. F. D. Morice, M.A., F.E.S., Queen's College.

Nov. 17, p. lxxi. Exhibition of a teratological specimen of a Carabid beetle from Ceylon, by Dr. G. B. Longstaff.

Dec. 1, p. lxxii. Exhibition of late autumn Coleoptera from Wytham Park, by Commander J. J. Walker, late R.N., F.L.S., F.E.S.

III. The following short papers have appeared in the *Entomologist's Monthly Magazine* for 1909 (second series, vol. xx):—

June, p. 132. Observations on *Empis opaca*, by A. H. Hamm.

July, p. 157. Further observations on the *Empinae*, by A. H. Hamm.

December, p. 273. *Setulia grisea*, Mg., and *Cerckeris arenaria*, L., in the New Forest, by A. H. Hamm.

December, p. 275. *Setulia grisea*, Mg., a Tachinid new to Britain, and its allies, by Colbran J. Wainwright, F.E.S.

December, p. 277. *Sitaris muralis*, Forst., n. var. *flava*, by A. H. Hamm.

April, p. 79. Notes on the British dragon-flies of the "Dale Collection" (II), by W. J. Lucas, B.A., F.E.S.

May, p. 106. Some notes on the Lepidoptera of the "Dale Collection" of British insects now in the Oxford University Museum. Bombycina, by James J. Walker, Hon. M.A., R.N., F.L.S. (Continued from vol. xliii, p. 158.)

August, p. 175. Continuation of the above. Geometrina and Noctuina.

IV. In *The Entomologist* for 1909 (vol. xlii):—

October, p. 253. A new genus and species of *Orneodidae*, by T. Bainbrigge Fletcher, R.N., F.E.S. A description of *Microschismus antennatus*, a unique and remarkable "Plume-moth" captured by E. N. Bennett, M.A., Hertford College, at Blockhouse No. 74, near Bothaville, Valsch River, Orange River Colony (May 1, 1902).

V. In *Novitates Zoologicae*, vol. xvi, 1909:—

December, p. 309. On some of the African Longicorns described by Hope and Westwood, by K. Jordan, Ph.D.

The papers on Orthoptera, except those of Mr. R. Shelford in *Trans. and Proc. Ent. Soc., Lond.*, are printed in the following list:—

By R. Shelford:—

Descriptions of some new genera and species of *Blattidae*. In *Deutsch. Ent. Zeitschr.*, 1909, p. 611.

Blattidae. In *Die Fauna Südwest-Australiens* (Michaelsen and Hartmeyer Expedition), Jena, 1909, p. 129.

Blattidae of Spanish Guinea. Memoria 27. In *Memorias de la Real Sociedad Española de Historia Natural*, Tomo I, 1909.

By Dr. Achille Griffini (R. Istituto tecnico, Genova, Italy):—

Révision des types de certaines *Gryllacris* décrites par F. Walker, existant au Musée d'Oxford. In *Deutsch. Ent. Zeitschr.*, 1910, p. 82.

Studi sui *Grillacridi* del Museo di Oxford. Parte I^a. Specie etiopiche, indo-malesi ed australiane. *Atti della Società Italiana di Scienze Naturali*, vol. xlvii, 1909.

Two new species of *Gryllacris* in the University Museum, Oxford. *Ann. Mag. Nat. Hist.*, ser. 8, vol. iii, April, 1909, p. 366.

The account of the Nymphaline butterflies collected by W. J. Burchell in Brazil (1825–1830) was completed by the appearance of two papers in *Ann. Mag. Nat. Hist.*, ser. 8, vol. iii, Jan., 1909, p. 7, and Feb., 1909, p. 98, by J. C. Moulton, Magdalen College. These two memoirs contain an account of specimens numbered from 836 to 1283. Two new species have been described as *Phyciodes burchelli* and *P. pedrona* respectively.

In addition to the above, Dr. G. B. Longstaff, Commander J. J. Walker, and the Professor have sent large numbers of living insects to Mr. R. I. Pocock, F.L.S., F.Z.S., in order to test the preferences of insect-eating vertebrates, especially

birds, in the Zoological Gardens. Mr. Pocock has, as the result of his experiments, recorded a large number of observations bearing upon the theories of cryptic and warning colouring and mimicry. These notes and conclusions will be published by the Zoological Society at no distant date.

15. *The Hundredth Anniversary of the Birth of Charles Darwin.*

An examination of the Diptera of the Hope Collection revealed a number of flies collected by Charles Darwin in Australia and Tasmania during the voyage of the *Beagle*. These specimens, which are still in excellent condition, were exhibited at the soirée in the Examination Schools on February 22, 1909. With these were also shown one of the collecting cases taken by Darwin on the voyage, and an interesting letter written by him to Rev. F. W. Hope in 1837, and referring to the insects which he had brought home. This letter is now published (*Darwin and the "Origin,"* Poulton, 1909, p. 202).

The Diptera of the voyage referred to above also formed part of the Darwin Exhibition at Christ's College, Cambridge, in the summer of last year.

16. *Seventh Volume of Hope Reports.*

Early in the present summer it is hoped that a seventh volume may be issued. Abundance of material for this purpose exists in the Department.

ADDITIONS TO THE COLLECTIONS IN 1904.

The following specimens from Dr. G. B. Longstaff's great Oriental collection, made in 1904, had been added to the bionomic series and were inadvertently uncatalogued until last year:—

Four butterflies observed to emit pleasant or unpleasant scents; the Lycaenid butterfly *Deudorix melampus*, set to show the appearance of a head at the posterior end of the insect, in the resting position.

An Ichneumonid (*Ophioninae*) with a yellowish substance, probably a pollen-mass, adhering to its head, captured at Dodington, Kent (May 27, 1904), and presented by the late A. J. Chitty, Esq., K.C., M.A., F.E.S., Balliol College, which had been inadvertently overlooked, has now been catalogued and added to the collection.

ADDITIONS TO THE COLLECTIONS IN 1905.

The following specimens of the great 1905 collections made by Dr. G. B. Longstaff in S. Africa and Algeria, and by Dr. F. A. Dixey in S. Africa, and for various reasons omitted from the catalogue of 1905, have now received their numbers:—

(1) Dr. G. B. Longstaff's collections.

South Africa: 11 Coleoptera named by L. Péringuey, Esq., in the South African Museum, Cape Town; 7 Hymenoptera, 3 of them named by the late Col. C. T. Bingham; 4 male butterflies (of different species) observed to emit an agreeable odour; 2 butterflies in which both sexes emit an unpleasant odour; 1 Lycaenid butterfly with an injury to the "tail" of the hind wing.

Algeria: 6 small moths; 19 Diptera named by G. H. Verrall, Esq., M.P., F.E.S.

(2) Dr. F. A. Dixey's collection.

South Africa: 2 Coleoptera named by L. Péringuey, Esq.; 1 bee named by the late Col. Bingham; 2 butterflies with pleasant scent in males and 1 unpleasant in both sexes; 1 *Salamis anacardii* set to show position of rest.

The white black-marked Hesperid butterfly *Abantis lezabu* taken with 3 *Pierinae* at Taveta, British East Africa (1905), was presented to the bionomic collections by the captor, Rev. K. St. Aubyn Rogers, M.A., F.E.S., Wadham College (Trans. Ent. Soc., Lond., 1908, pp. 539, 540).

Sixty-three Lepidoptera from Entebbe and Kampala or between the two (1905), were presented by the captors, Professor E. A. Minchin, M.A., Keble College, and Mrs. Minchin.

The specimens include 1 *Salamis cacta*, 1 *Pseudacraca albo-striata*, and many *Acraca orina* or a form closely allied to it. The data are admirable and the specimens of much value to the Department.

ADDITIONS TO THE COLLECTIONS IN 1906.

One hundred and eighty-two butterflies, collected in N.E. and N.W. Rhodesia (1904-5) by S. A. Neave, Esq., M.A., B.Sc., Magdalen College, and presented by him and the British South African Company, have been added to the collection. The series includes 5 *Acraca leucopyge*, 1 *A. violarum umbrata*, 1 *Papilio mackinnoni benguelae*, and male and female co-types of a new *Sarangesa* (to be described as *S. nov* in Mr. Neave's forthcoming paper in the Proc. Zool. Soc. Lond.). The addition of these specimens, of which half have been catalogued as permanent accessions, completes the incorporation of the earlier collection of butterflies made by this generous friend of the Department. Some account of the collection (of which 1,278 specimens were catalogued) and of the parts of Africa which it represents was published in last year's Report.

Two very interesting sets of mimetic butterflies and their models, presented by the captor, Rev. K. St. Aubyn Rogers, M.A., F.E.S., Wadham College, have been incorporated in the bionomic collection.

The first, consisting of 21 specimens captured on the slopes of Kilimanjaro (Jan. 5-16, 1906), contains 5 *Amauris albimaculata* (*Danainae*), two of its Papilionine mimics (2 *ceuea* females of *P. dardanus tibullus* and 3 males of *P. echerioides*, of which the female is a mimic), and several specimens of its Acraeinae mimics *A. johnstoni* and *fallax*. Also the *dorippus* form of *Danaïda chrysippus*, together with Acraeas resembling it—the *fulvescens* form of *A. johnstoni* and the *daira* form of *A. encedon*.

The second includes the male of the beautiful Nymphaline mimic of the large red and black Acraeas, *Pseudacraca*

trimenii, together with the males of two of its models, *A. aemosa arcticincta* and *A. natalica*, all captured July 18-19, 1906, at Mangua, near Mombasa.

Eight very interesting British East African butterflies were presented by E. A. Elliott, Esq., F.E.S. They include a remarkable form of the female of *P. dardanus tibullus*, captured at Nairobi (1893) by C. F. Elliott, Esq. This specimen, which bears considerable resemblance to the *dorippus* form of *Danaida chrysippus*, has been described as the type of *dorippoides* by Roland Trimen, Esq., Hon. M.A., F.R.S., &c. (Trans. Ent. Soc., Lond., 1908, p. 554). Other specimens are a male and female of *Acraca asboloplintha rubescens* (Nairobi, C. F. Elliott, 1892-3), a fine *Belenois*, as yet undetermined (Londiani district, 1904), 3 other *Pierinae* from Nairobi, and one from Malindi, at the mouth of the Sabaki River.

Eight insects, including British Neuroptera (Surrey, 1898-1902: New Forest, 1900-1), and *Acridiidae* from Cape Colony, were presented by W. J. Lucas, Esq., B.A., F.E.S.

ADDITIONS TO THE COLLECTIONS IN 1907.

In addition to the fine series of New World insects captured in 1907 and presented by Dr. G. B. Longstaff and acknowledged in the Report of last year, the following specimens of the same collection have been catalogued in 1909:—

Ten butterflies from Jamaica and ten of the forms most nearly allied to them from the mainland. The island forms are as a rule the brighter.

Ten butterflies in which the males possess an agreeable scent, and ten in which both sexes possess an unpleasant scent.

Five Lycaenid butterflies set to show the appearance of a head with antennae at the posterior end of the insect when in the position of rest.

A yellow Pierine butterfly (*Callidryas*) seen to fly across the race-course at Montego Bay, Jamaica (Feb. 4, 1907), and settle on a single conspicuous yellow leaf of *Ipomaea pes-caprae*.

Ten wet season and dry season forms of *Precis* and *Pierinae*.

Three Jamaican Satyrine butterflies (*Calisto zangis*) set to show the exposure of the eye-spot at the anal angle of the under surface of the hind wing. The anal angle is bent at right angles to the plane of the wing so that the ocellus can be seen from above.

Three examples of a Jamaican Hesperid butterfly and 2 of a Jamaican Uraniid moth set to show the position and plane of the "tails" of the hind wings when the insect is at rest.

All these instructive illustrations were prepared under the direction of Dr. Longstaff or selected by him from the collection.

A male specimen of the beautiful Nymphaline mimic, *Pseudacraea trimenii*, and one of its Acraeine models, *A. arcca*, captured on the same day (Nov. 3, 1906) at Rabai, near Mombasa, and presented by Rev. K. St. Aubyn Rogers, M.A., F.E.S., Wadham College, have been catalogued and added to the bionomic series.

ADDITIONS TO THE COLLECTIONS IN 1908.

Six *Phasmidae* ("stick insects") of an Indian species, a product of breeding for several generations in this country, were presented by J. W. Carter, Esq. The breeding was in part at least parthenogenetic. The species is at present undetermined.

Thirty-two insects of various groups from Ootacamund, S. India (April–September, 1908), were presented by the captor, Miss Ruth Harrison, of Lady Margaret Hall.

Nineteen Coleoptera from Stellenbosch, Cape Colony (1908), were presented by the captor, Miss L. C. Blundell.

Six insects from Pondoland, Cape Colony (1907–8), were presented by the captor, F. H. Cowl, Esq.

The very fine collection of insects made in Ceylon by Dr. G. B. Longstaff, D.M., New College (1907–8), was only provisionally acknowledged in last year's Report. It has now

been labelled, catalogued, and incorporated. An analysis of it is printed below:—

Lepidoptera Rhopalocera	.	.	943	specimens
„ Heterocera	.	.	188	„
Hymenoptera	.	.	285	„
Diptera	.	.	24	„
Coleoptera	.	.	59	„
Rhynchota	.	.	76	„
Neuroptera	.	.	32	„
Orthoptera	.	.	64	„
ARACHNIDA	.	.	9	„
Total	.	.	1680	

Of these, over half (890) have been catalogued and large additional numbers of specimens also incorporated in the collection. The specimens are accompanied by admirable data of place and time, and the great majority of them have been worked out by the donor and the authorities consulted by him. Although the Oriental Region, including Ceylon, is fairly well represented in the Hope Collection, it is most important to replace all specimens with imperfect data, and this means almost the whole of the older material. Such replacement on a large scale has been rendered possible by means of Dr. Longstaff's specimens, which have also contributed many species hitherto unrepresented in the Department.

In addition to the above, Dr. Longstaff contributed 59 specimens from Ceylon to the bionomic collections. They include butterflies of which the scents were recorded in the fresh state, as well as the other material described in the donor's memoir in *Trans. Ent. Soc., London, 1908, p. 607*.

One hundred and sixty-five insects of various groups from the neighbourhood of Bombay (1908) were also presented by the same generous donor. Of these 131 have been catalogued and incorporated. The specimens added to the bionomic collections include some wonderful Dipterous mimics captured at the same time and place as their Hymenopterous models.

Dr. Longstaff also presented 8 insects captured (Dec. 1907) on the voyage,—7 from the Sweet-water canal at Port Said, and an Acridian which flew on to the ship in the Red Sea.

Thirty butterflies from the Ja River, Cameroons, were presented by Herbert Druce, Esq., F.L.S., F.Z.S., F.E.S. Specimens from this part of W. Africa are greatly needed by the Department, and the gift is especially welcome. Two fine examples of the Geometrid moth *Larentia autecharidani*, from Peru (1905), were presented by the same generous donor.

Some of the butterflies from the Tian Shan Mountains (about 1906) purchased from H. Grose-Smith, Esq., F.E.S., and in part mentioned in last year's Report, proved when set to be in bad condition. Owing to various circumstances Mr. Grose-Smith was unable to replace these before his whole collection was sold to Major Joicey. When the facts were explained, Major Joicey not only permitted more perfect specimens to be taken, but also generously presented a number of additional specimens from the same set of duplicate Mongolian species. The locality renders all these of especial value and interest.

ADDITIONS TO THE BRITISH COLLECTIONS IN 1908.

At the time when last year's Report was prepared it had only been possible to catalogue one important series of accessions to the British Collections, viz. that presented by Dr. Longstaff from N. Devon. The following donations have now been incorporated :—

A very rare Hemipteron (*Mictatropis rufescens*) from the New Forest (June, 1908) was presented by the captor, Commander J. J. Walker, Hon. M.A., F.L.S., F.E.S. (Entom. Monthly Mag., 1908, p. 186); also, for the bionomic collection, two butterflies (I. of Sheppey, Aug. 1908) with their wings symmetrically injured.

Twenty Lepidoptera, chiefly from Northamptonshire and Norfolk (1908), were presented by the captor, C. Mellows, Esq., Brasenose College. The species included *Thecla W-album*, *Nonagria cannae*, *Tapinostola clymi*, *Cœnebia rufa*, and *Taeniocampa miniosa*. All the specimens possess excellent data.

Twenty miscellaneous insects from St. Helens, Isle of Wight, and Donabate near Dublin (1908) were presented by the Professor.

One *H. semele* (Wiltshire, Aug. 1907) was presented by the captor, Mr. S. H. Paviere.

A hornet, *Vespa crabro* (Twickenham, 1903), was presented by the captor, Rev. M. W. Myres.

Fourteen *Acridiidae* (Surrey, Sept. 1908), including *Gomphoceris rufus*, *Stenobothrus bicolor*, and *S. parallelus*, were presented by the captor, W. J. Lucas, Esq., B.A., F.E.S.

Fifty-six miscellaneous insects, chiefly Diptera, from Sutherlandshire (July, 1908), but also including a few from Bagley Wood, near Oxford (June, 1908), were presented by the captor, R. Shelford, Esq., M.A. Cantab., F.L.S., F.E.S.

Paniscus cephalotes, an Ichneumonid parasite, was bred, May 9, 1908, from the cocoon of *Dicranura vinula* (the "Puss Moth"), and presented by Miss Winnie Holland. The larva had been found at Tilehurst, near Reading.

Three *Bombylius* and a Curculionid beetle from Weston-super-Mare (April, May, 1908) were presented by the captor, Dr. W. H. Jackson, D.Sc., M.A., Keble College.

Four examples of the dragon-fly, *Lestes sponsa* (Brockenhurst, Aug. 1908), were presented by the captor, Mr. A. H. Hamm, of the Hope Department.

The following specimens were captured by the donors in the Oxford district (1908):—

A "Plume Moth," *Pterophorus monodactylus* (Tubney, Oct.), was presented by J. C. Moulton, Esq., Magdalen College.

The Scottish Longicorn *Acanthocinus aedilis* (outside a window in Adelaide Street, Oct.) was presented by Mr. H. Hambidge (Entom. Monthly Magazine, 1908, p. 272).

A *Bombylius*, Oxford (April, 1908), was presented by A. J. M. Bell, Esq., M.A., Balliol College.

Two moths (University Museum, July; Tubney, Nov.) were presented by Mr. W. Holland, of the Hope Department.

Twenty miscellaneous insects from a number of localities near Oxford, were presented by Mr. A. H. Hamm, of the Hope Department.

Eleven miscellaneous insects, chiefly from the Oxford district, but including a few from Lancashire (1904), were presented by Mr. J. Collins, of the Hope Department.

ADDITIONS TO THE COLLECTIONS IN 1909.

The accessions from the Ethiopian Region were, as in previous years, the principal feature of 1909.

The most important donation of the year is the remarkably fine collection of insects of all orders made in Northern Rhodesia and presented by S. A. Neave, Esq., M.A., B.Sc., Magdalen College. Of this splendid accession, which has occupied a large proportion of the assistants' time during the past year, only the Orthoptera and the butterflies captured in 1908 in the following N.E. Rhodesian localities have been catalogued:—

Luangwa Valley, Petauke (2,400 ft., Jan.); mid Luangwa Valley (1,700 ft., Feb.); Upper Valley (1,800–2,000 ft., Mar.).

Near Mirongo, edge Mchinga Escarpment (3,500 ft., April).

Chinsali (4,300 ft., April); in the mid Chambezi Valley, Chinsali district (4,000 ft., April); in the lower Chambezi Valley, Mpika district (May); Kasama district (3,900 ft., April, May).

N. and E. shores of Lake Bangweolo (3,800 ft., May); Chishi and Chirui Islands in the lake (June, July); Luwingu, N. of the lake (4,200 ft., June, July).

Mporokoso (4,500 ft., July, August).

Upper Kalungwisi Valley (4,200 ft., July, Sept.); in dense forest in the lower part of the same valley (3,500 ft., Sept.).

Lofu River (4,000 ft., August).

The high plateau S. of Lake Tanganyika (4,500 ft., August).

Chisinga Plateau, Kalungwisi district (4,500 ft., Sept.).

From these localities 2,152 butterflies belonging to the following groups were presented by the generous donor:—*Danainae* 18, including a remarkable variety of the *alcippus* form of *Danaïda chrysippus*; *Satyrinae* 170; *Nymphalinae* 251, including co-types of *Neptis jordani*; *Acracinae* 356, including co-types of *Acraea detecta*; *Lycanidae* 503, including co-types of *Spindasis trimeni* and *Aphnacus marshalli*; *Erycinidae* 2;

Pierinae 171; *Papilioninae* 24; *Hesperiidae* 657, including co-types of *Platylesches robustus*, *Parnara larca*, *P. chambezi*, *Sarangesa maxima*, *Platylesches lambi*, and the type of *Kedestes malua*. This series forms part of the collection described by Mr. Neave in a paper soon to be published in the Proc. Zool. Soc., London. The type and co-types are of new species described by the author in this memoir.

Orthoptera 1,512, including no less than 1,408 *Blattidae* and comparatively small numbers of the other families.

Fourteen specimens were also added to the bionomic collection, including an Asilid fly and its Orthopterous prey.

Out of this large collection, provided with admirable data, 1,374 specimens have been catalogued, and not only these, but a very large additional number, incorporated in the collection.

The following valuable and numerous accessions are due to the generosity of Rev. K. St. Aubyn Rogers, M.A., F.E.S., Wadham College. The specimens are arranged according to their localities:—

Rabai (700 ft.), 14 m. N.W. of Mombasa (1908-9):—12 moths and 216 butterflies including the following. The *dorippus* form of *Danaida chrysippus* with unusually distinct traces of the white subapical bar of the fore-wing—a character of *chrysippus*; *Acraea satis* (males and females); a beautiful variety of *Acraea terpsichore*; a form of *A. quirina*. Among the *Nymphalinae*, *Pseudacraca trimenii* (including 2 males without the ochreous subapical bar of the fore-wing), *Euxanthe tiberius*, *Neptidopsis fulgurata platyptera* (2 pairs in coitu), *Charaxes lasti*, *Ch. azota*, *Ch. violetta* and *Ch. ethalion* (female), *Eurulia deceptor*; among the *Lycaenidae*, many *Lipteninae*, including *Pentila peucetia* and *Telipna rogersi*.

For the bionomic collection:—5 *Asilidae* and their prey—3 flies, a beetle, and a Pierine butterfly (*Terias*); a Mantis and its prey—a bee; a Lycaenid butterfly (*Pentila*) injured, probably by a bird; a Danaine butterfly (*Amauris ochlea*) rejected by spiders.

For the mimicry series:—the large black and white Danaine *Amauris niavins dominicanus*, captured with two examples of its mimic the *hippocoön* female form of *Papilio*

dardannus tibullus, on June 21, 1909; the smaller black and white Danaine *A. ochlea*, captured with the following mimics,—*Euralia deceptor* (male and female), *Pseudacraea lucretia expansa*, and *Euxanthe wakefieldi* (male, the female is the mimic), on July 3, 1909.

Ndzovuni (about 700 ft.), about 30 m. N. of Rabai (July, 1909):—12 butterflies, including *Charaxes azota* and some interesting *Lycaenidae*.

Jilore (about 200 ft.), about 80 m. N. of Mombasa (July, 1909):—14 butterflies, including a *Lycaenid*, *Virachola dinochares*, new to the collection, and males and females of *Pinacopteryx spilleri*.

For the bionomic series:—12 *Acraeas* of 7 species. All these forms, of which the males, and in some species the females also, are red black-marked insects, were captured on the same day, July 10, 1909. Also an Asilid fly with its prey—a Pierine butterfly.

Jimba (about 700 ft.), about 3 m. W. of Rabai (Aug. 14, 1909):—7 *Teracolus दौरा*.

Mombasa (June 16, 1909):—A fine Sphingid moth.

Nairobi (about 5,500 ft.: June 12, 1909):—3 butterflies.

Voi River, 7 m. W. of Voi station on the Uganda railway (Oct. 9, 1909):—3 butterflies.

Dabida Mountain (4,500 ft.), about 100 m. N.W. of Mombasa (Oct. 13, 1909):—8 butterflies, including a very fine white-marked female of *Acraea johnstoni* and 2 male *Planema montana*.

Wusi (4,200 ft.), near Dabida (Oct. 11, 1909):—3 butterflies.

The same generous donor also presented as material for study in the Hope Department the results of two breeding experiments conducted by him at Rabai.

The first consists of a female *Hypolimnias misippus* (captured at Rabai, Oct. 31, 1908), intermediate between the type and the var. *inaria*, together with 49 females and 7 males (being all that were kept of this sex) reared from its eggs. The whole of the female offspring were of the *inaria* var., although, at Rabai, this form is no commoner than the type. These results are perhaps due to the Mendelian dominance of *inaria*

over the type form of female (Proc. Ent. Soc., Lond., 1909, pp. xxxvi, xxxvii).

The second consists of the butterflies bred, in September, 1909, from a single company of larvae of *Belenois severina*. Part of these larvae were fed from an early stage, when quite small, upon young fresh leaves,—the other part upon old dry leaves. The latter were accidentally starved in the last stage, and the butterflies (26) that emerged from their pupae are considerably smaller than those (22) produced by the other set. Before starvation, however, the larvae of the second set, growing more slowly, appeared likely to produce larger butterflies than those of the first.

In addition to the above described valuable accessions which have been incorporated, and are now gratefully acknowledged, very large numbers of specimens presented by the same donor are being catalogued and will be described in detail in the report of next year.

Ninety-eight Blattidae collected in the Congo basin by Dr. Sheffield Neave were presented by le Musée du Congo, Brussels. The collection includes co-types of the following new species described by Mr. Shelford:—*Ischnoptera bisignata*, *Ectobius neavei*, *Loboptera unicolor*, *Blatta barbara*, *Stylopyga immunda*, *S. neavei*, and *Bantua valida*.

A set of 178 butterflies, 23 moths, 2 Odonata, and 1 beetle, captured in Sierra Leone (1908) by Q. M. Sergeant Lawrence, was purchased for the Department. Among the butterflies is the male of the rare *Mimacraea fulvaria*, and several other specimens wanted in the general collection, and a few which have been added to the bionomic series.

In the Report of 1908 mention was made of 7 *Charaxes neanthes* and 1 *C. zoolina* bred at Durban from the eggs laid by a female *neanthes* by Mr. G. F. Leigh, F.E.S. These examples, the first convincing evidence of the long-suspected specific identity of the two forms, were purchased for the Department. During the year 1909 the same keen naturalist and observer has confirmed his previous evidence in the most satisfactory way by breeding from a female *zoolina*. The parent, captured at Durban (April 3), laid 49 eggs (April 3-6)

from which Mr. Leigh bred 4 male and 2 female *zeelina*, and 6 male and 9 female *neanthes*, the butterflies emerging in June and July. These specimens also have been purchased for the Department. (Proc. Ent. Soc., Lond. 1909, xlix, 1, where most unfortunately the number of male *neanthes* is given as 15 instead of 6.)

A splendid collection of mimetic butterflies and their models collected at intervals from May to September, in a small patch of forest near Entebbe, has been presented by C. A. Wiggins, Esq., M.R.C.S., of Entebbe. Although in large part set and labelled, the specimens are not yet catalogued, and their detailed acknowledgement must be reserved for next year's Report. It is not too much to say that this material will throw more light on the study of mimicry than any that has ever been collected in a limited time in a single locality.

Chief among the accessions from the Neotropical Region is an exceedingly fine set of 6,625 insects from Central America, presented by Dr. F. D. Godman, Hon. D.C.L., F.R.S. This very valuable collection is made up of duplicates from certain sections of the great mass of material upon which the *Biologia Centrali-Americana* has been written. The groups represented and the number of specimens in each are recorded below:—

Coleoptera	4856
Rhynchota (chiefly Hemiptera-Heteroptera) .	1620
Hymenoptera	149
Total	6625

The value of the collection is immensely increased by the full geographical data and the fact that the species have been determined by the distinguished authorities who have worked out the groups and their subdivisions for the *Biologia Centrali-Americana*.

An extremely interesting specimen of the rare Castniid moth *Castnia thearon*, together with its pupa-case, was presented by Dr. Alfred Russel Wallace. The moth was caught flying in Dr. Wallace's orchid-house at Broadstone, on Dec. 26, 1908, and the pupa-case was found among the roots of a *Stanhopea* which had been more than a year in the house.

and before this "some years" in Mr. Hall's conservatories, Buenos Ayres. The orchid, and undoubtedly the Castniid larva within it, had originally come from Santos, Brazil. (Proc. Ent. Soc., Lond., 1909, pp. xxxiv, xxxv.)

Eight *Heliconiinae*, much wanted for the collection, were presented by W. J. Kaye, Esq., F.E.S. They included the Peruvian species, *H. microclea*, described by the donor, and *H. chestertonii*. The same kind friend of the Department also presented *McLinaca messatis*, together with its mimics, a *Heliconius* and an *Archonias* (*Pierinae*), all three species being present in one consignment, from Medellin, Colombia.

Thirty-two Peruvian moths were presented by Herbert Druce, Esq., F.E.S., F.L.S., F.Z.S. All the specimens were named by the donor, who had described 7 out of the 8 species represented in the series. These are only a very small part of the splendid accessions which the University owes to the generosity of the donor, as is abundantly testified by the reports of previous years and as will be shown again when large numbers of specimens now in the Department are catalogued and incorporated.

One *Morpho cacica* and 2 *Catagramma excelsior*, from Peru (1904), were presented by H. Eltringham, Esq., M.A., New College. These fine species were unrepresented in the general collection. Mr. Eltringham also presented the unique type of a very interesting mimetic West African Lycaenid butterfly described by him as *Mimacraea neavei* (Entomologist's Monthly Mag., 1909, p. 172). The specimen reached the donor among a number of *Acraea oberthüri*, to which it bears so astonishingly close a resemblance as entirely to deceive the naturalist from whom the insects were obtained. The locality is the Cameroons.

Among the additions to the collections from the Oriental and Australian Regions, ten examples of the moth *Aulacodes simplicialis* (*Hydrocampinae*) and of the Ichneumonid parasitic upon it were presented by the captors, F. Muir, Esq., F.E.S. and J. C. Kershaw, Esq., F.E.S. The specimens, taken Nov. 1908, on Lappa Island on the west side of Macao Harbour, were exhibited to the Entomological Society, June 2, 1909,

to illustrate an interesting paper (Proceedings. pp. xl-xliv) on the life-history of the moth and its aquatic larva. The same donors also presented 16 small moths taken at sea, Nov. 29, 1908, and one, the Syntomid *Euchromia polymena*, captured in December. The majority of the captures on Nov. 29 belong to two species of *Pyralidae*,—*Schoenobius incertulas* and *S. bipunctifera*, but they also included the small and delicate "plume-moth," *Alucita niveodactyla*. A fresh wind was blowing from the N.N.W., and all these moths were captured flying over and settling on the ship, at a point about 190 miles S.S.E. of Lower Cochin China and 120 N.N.W. of Great Natunas. The moths were seen resting on the sea, even on the broken water round the bows of the ship, and again rising and pursuing their flight. The observation bears directly upon the means by which such insects are distributed to islands, &c. (See Proc. Ent. Soc., Lond., 1909, pp. xxxviii-xl.)

Nine Hymenoptera from Queensland (1900) and N. S. Wales (1909) were presented by Rowland E. Turner, Esq., F.E.S.

Distysidera flavipes, a rare "tiger-beetle" from Cairns, Queensland, was presented by Dr. W. Horn, of Berlin.

A collection of Orthoptera from various islands of the Malay Archipelago was presented by the Professor. The specimens, which formed part of the recently dispersed Van der Poll collection, consist of the following:—*Forficulidae*, 10; *Blattidae*, 103; *Mantidae*, 70; *Phasmidae*, 332; *Acridiidae*, 57; *Locustidae*, 85.

The following valuable accessions, belonging to various groups and from various parts of the world, were presented by the Hon. Walter Rothschild, M.A., F.Z.S., F.E.S.

Thirty butterflies and 6 moths from German New Guinea, and 8 butterflies from New Ireland. The Hope Collection is poor in specimens from this very interesting and important part of the world, and the accessions are most welcome.

Twenty-two *Papilioninae* from various localities, chiefly Oriental (China, Hainan Island, German New Guinea, Philippine Islands, Tonkin, Amboyna, the Natunas Islands, Brazil).

Twenty-five Longicorn beetles from the Ethiopian Region,

including co-types of *Callichroma concentricale*, Jordan, and *Aulacopus thoracicalis*, Jordan.

A fine male example of *Tirumala (Melinda) morgeni* from Bipindi, Cameroons (Dec. 1899), is of the highest interest for the study of mimicry. *Tirumala* is an Oriental and Austro-Malayan genus of Danaine butterflies, of which representatives have invaded the Ethiopian Region from the east. The most eastern of the intruders, *T. formosa*, has departed least from the appearance presented by the Oriental species of the genus. On the west shores of the Victoria Nyanza we meet with a second species, *T. mercedonia*, far more modified and much darker than *formosa*. Finally on the west coast the rare *T. morgeni* has changed far more completely in the same direction and has become a black white-marked butterfly and a wonderful mimic of the indigenous Ethiopian Danaines of the genus *Amauris*. Probably no single specimen ever received is of so much interest in relation to the special work of the Department, as this generous donation from the neighbouring Zoological Museum at Tring.

Eleven *Acridiidae* and 2 *Locustidae* were presented by Dr. Malcolm Burr, D.Sc., F.G.S., F.E.S., New College, to whom the University is indebted for many large and important additions to the collection of Orthoptera.

Six *Hesperiidae* from various localities were presented by H. H. Druce, Esq., F.L.S., F.E.S. The specimens were much wanted in the general collection.

The Hesperid butterfly, *Paraminus stigma*, from Taboga Island, Bay of Panama (Oct. 1881), was presented by the captor, Commander J. J. Walker, R.N., Hon. M.A., F.E.S., together with 3 Castniid moths, *Synemon sophia*, from Subiaco, near Fremantle, W. Australia (Nov. 1890).

Commander Walker also presented to the bionomic collection an example of the Longicorn beetle, *Tragocerus formosus*, from Cooktown, N. Queensland. This species is of peculiar interest in relation to the study of mimicry in Coleoptera. It is common for beetles, especially Longicorns, to mimic the black-and-yellow-banded stinging Hymenoptera. In many of them, the characteristic pattern exists on the body of the

beetle and is revealed when the wings are raised. In these the elytra or "wing-covers" are often reduced, becoming very narrow or small and scale-like. In others, the elytra, at rest and completely covering the hind wings, are themselves banded like a wasp. Our own "wasp-beetle," *Clytus arictis*, is a well-known example. The effect of this latter form of resemblance is of course lost when the elytra are raised and separated in preparation for, and during, flight. In *Tragocerus*, however, Mr. Gahan has pointed out that the elytra, which bear the peculiar and characteristic pattern of many Australian wasps, are so shaped that the wings are probably used when their "covers" are closed. The side of each elytron is, as it were, cut out opposite to the hinge of the organ of flight. The specimen presented by Commander Walker has been set with fully expanded hind wings projecting through the arch-like emargination in the sides of the closed elytra.

Seven Aculeate Hymenoptera, from the flowers of a single tree of *Ochrademus baccatus*, in the dry bed of the Wady Kelt, near Jericho (April 2, 1909), were presented by the captor, Rev. F. D. Morice, M.A., F.E.S., Queen's College. During life, the resemblances between the species, which belong to various groups, were very marked. The association, which is probably Müllerian, was exhibited by the donor to the Entomological Society of London on Nov. 3, 1909 (see p. 14).

A fine series of 468 Lepidoptera, chiefly butterflies, from Banyuls-sur-Mer and Argelès-sur-Mer, at the eastern extremity of the Pyrenees (July and August, 1909), was presented by the captors, W. F. Lanchester, Esq., M.A., of King's College, Cambridge, and Professor E. A. Minchin, M.A., Keble College. About half have been catalogued and, with many additional uncatalogued specimens, incorporated in the collection. The *Satyrinae* are especially well represented by 155 specimens. The collection includes a specimen of the "Humming-bird Hawk-moth" (*Macroglossa stellatarum*) with its "tongue" fixed in the flower of a creeper, apparently an Asclepiad. This moth, which was found dead hanging from the flower, on Aug. 3, is an interesting addition to the

bionomic series. The whole collection, accompanied by admirable data, is a valuable accession to the European species—at present rather weakly represented in the Department.

The material of their great Mendelian experiment in moth-breeding has been generously presented to the Department by L. B. Prout, Esq., F.E.S., and A. Bacot, Esq., F.E.S. The special interest of this important accession has been pointed out in a separate section of this Report (see p. 4).

ADDITIONS TO THE BRITISH COLLECTIONS IN 1909.

The collection of British Diptera has again received a splendid series of accessions owing to the generous assistance rendered by Col. J. W. Yerbury. The British Diptera—amounting to considerably over 1,500—which have been catalogued and incorporated have been determined by G. H. Verrall, Esq., J. E. Collin, Esq., or by Col. Yerbury himself, and the written or printed name is affixed to every specimen.

The numerous localities are distributed over the following counties:—Caithness (1899), Elginshire (1899), Invernesshire (1904-5), Nairnshire (1904-5), Perthshire (1898), Sutherlandshire (1900, 1904), Glamorganshire, many localities (1907-8), Herefordshire, many localities (1897-1906), Devonshire (1896, 1903, 1909), Dorset (1894, 1906-7), Hampshire (1897, 1908-9), Oxfordshire (1907), Nottinghamshire (1906), Cambridgeshire (1898, 1909), Norfolk (1906), Suffolk, many localities (1907-9), Essex (1899, 1907-9), Surrey (1906), Kent (1897, 1907-8), Co. Kerry (1901). The collection also included specimens from the Scilly Islands, St. Mary's and Tresco (1904). The data of time and place are admirably precise. In addition to this magnificent accession, Col. Yerbury presented 24 British insects belonging to various groups, and 44 specimens for the parts of the bionomic series which illustrate the struggle for existence in insects. They include 9 Asilid flies and their prey—Dipterous in 6 cases, a Tenthredinid in one, and an Acridian in one. Two male *Asilus crabroniformis* were captured (Studland, Aug. 3, 1909) with the Acridian, the probable interpretation being that while

one of these was engaged in sucking the juices of the grasshopper, he was swooped down upon, and was being devoured by the other male. Eighteen specimens illustrated the attacks of predaceous Diptera other than *Asilidae*. Some of these Diptera were paired when captured, the females being in possession of prey. The remaining accessions were a dragon-fly and a Fossorial wasp with their prey, and a fly which had been captured feeding on a dead Hemipterous insect.

Thirty-five Coleoptera from various British localities were presented by Horace Donisthorpe, Esq., F.E.S., thus bringing the number of British species presented by him up to Jan., 1909 to 1,403.

Mr. Donisthorpe also presented 10 specimens of various groups, including the following interesting accessions:—

The wood-destroying beetle, *Bostrichus capucinus*, together with the Ichneumonid parasitic upon it, both taken (1903) in the Millwall timber-yard, E.

A specimen of *Gonatopus myrmecophilus*, new to Britain, from Deal.

Locusta viridissima, from Sandown, Isle of Wight (1908), and the Acridian *Pachytylus danicus*, taken (1908) by Captain Byng at St. Helens, Isle of Wight.

Large numbers of British Coleoptera, presented by the same generous donor, are still uncatalogued.

The following insects from the Oxford district (1909) were presented by the captor, Commander J. J. Walker, Hon. M.A., F.L.S., F.E.S.:—

Catocala nupta, at rest on the Mitre Hotel, Sept. 11.

Four *Acroccra globulus*, Cothill, July 23.

Two *Oncodes gibbosus*, Wytham Park, July 9.

A Culicid in the University Museum, Nov. 29.

Two Chrysidids, *Notosus panzeri*, the interesting bee, *Dasy-poda hirtipes*, and *Locusta viridissima*, Tubney, July 23, 28, and Sept. 15 respectively.

The Acridian *Tettix bipunctata*, Wood Eaton, March 26.

A fine example of *Sirex gigas*, Wolvercote, July 12.

The following insects were captured by the same generous donor in the New Forest (1909):—

Two *Raphidia* sp., Brockenhurst, June 5.

A Tenthredinid, Ramnor Enclosure, June 12.

The parasitic bee, *Melecta luctuosa*, Sway, June 14.

A female *Mutilla europaea*, Matley Bog, June 15.

Twelve larvae of *Hepialus lupulinus*, attacked by the fungus *Cordiceps entomorrhiza*, were presented by E. R. Bankes, Esq., F.E.S. The specimens had been found at Bognor (1908) by W. H. B. Fletcher, Esq., M.A., F.E.S.

Four male imagines of *Hepialus humuli*, attached to shoots of *Ulex europaea* and covered with threads of *Clavaria*?, were presented by the same donor, who had found the specimens in the Isle of Purbeck (1886 and 1890). See Proc. Ent. Soc., Lond., 1908, pp. xxv, xxvi.

Eight examples of *Tortrix pronubana*, from Eastbourne, were presented by R. Adkin, Esq., F.E.S. (Proc. South Lond. Ent. Soc., 1907–8, p. 20). The specimens, which were bred by Mr. Adkin, are a valuable addition to the British Collection.

A male and female of the rare and splendid Tipulid, *Ctenophora ornata*, bred June 27, 1907, from a New Forest parent, were presented by Dr. David Sharp, M.B., M.A., F.R.S., &c.

A Curculionid beetle, bred from a cocoon found (August, 1907) in a house in London, was presented by Mrs. Hauteville Cope.

A wood-boring beetle (*Bostrichidae*), probably of the genus *Apate*, found (1908) in the Pitt-Rivers Museum, near a war-drum from the Zambesi, was presented by H. Balfour, Esq., M.A., Trinity College.

The Dipterous bird-parasite, *Ornithomyia*, probably *avicularia*, was presented by W. H. Somerset, Esq. The donor had captured a young thrush with his hat (Wytham, June, 1909), in which the *Ornithomyia* was found half an hour later.

The same donor also presented the bee *Megachile willughbiella*, from Noke, near Islip, with the leaf-made cell from which it had emerged (July, 1909), and 2 Chalcids which had bored their way out of an adjacent cell.

A Culicid (Oxford, Nov., 1909) was presented by H. Eltringham, Esq., M.A., F.E.S., New College.

A pair of *Bibio marci*, captured *in coitu* near Newbury (May, 1909), and a Culicid, taken at St. Helens, Isle of Wight, were presented by the Professor.

Ten specimens of the Dipterous parasite, *Oxypterus pallidum*, taken from swifts' nests at Horsham, were presented by J. Walpole-Bond, Esq.

Seven early spring Noctuid moths from Castor-Hanglands, Northamptonshire (April, 1909), were presented by the captor, C. Mellows, Esq., Brasenose College. The donation permits the removal from the collection of old specimens without data.

Two specimens of the rare dragon-fly, *Somatochlora metallica*, from Crowborough, Sussex (August 5, 1909), were presented by the captor, E. R. Speyer, Esq., New College. (Entomologist's Monthly Mag., Oct., 1909, p. 227.)

Two specimens of the "Peacock butterfly" (*Vanessa io*), hibernating in the Physiological Laboratory, were presented by Professor Gotch, D.Sc., M.A., F.R.S. The butterflies, probably aroused by the warmth, emerged from their winter resting-place on Nov. 18 and 30 respectively. The specimens supply interesting evidence of the hibernation of the species in this country.

The Ephemerid, *Potamanthus luteus*, from Laleham-on-Thames (July, 1909), was presented by the captor, Perceval Boyd, Esq.

A *Locusta viridissima*, from Perranporth, Cornwall (Aug., 1909), was presented by the captor, Miss Edna Tickner.

A huge Lycosid spider, found on bananas at Oxford (June 1908), was presented by the captor, Mr. H. Smart.

Four Curculionid beetles from the White Horse Hill, Uffington (May, 1909), were presented by the captor, E. G. Joseph, Esq., Lincoln College.

Two Tortrices (1909) and the fly, *Chrysopa relictæ* (1904), from the neighbourhood of Oxford, were presented by the captor, Mr. W. Holland, of the Hope Department.

Three Tortricid moths, including a pair taken *in coitu*, one *Tipula gigantea*, and one Mycetophilid fly (*Platyura* sp.),

all from the neighbourhood of Oxford (1908-9), and a spider with its prey, the Geometrid moth, *Coremia quadrifasciaria* (Tubney, June, 1909), were presented by the captor, Mr. A. II. Hamm, of the Hope Department.

Two specimens of the interesting fly, *Borborus* (*Apterina*) *pedestris*, found in moss at Wytham (Jan., 1909), a pair of the Hemipteron *Miris erratica*, taken *in coitu* (Tubney, Oct., 1909), two *Ichneumonidae* bred (May, 1909) from Lepidopterous pupae from the Oxford district, were presented by Mr. J. Collins, of the Hope Department. Mr. Collins also presented two Coccinellid beetles of different genera taken *in coitu* (Tubney, August 5, 1908), viz. *Adalia obliterated* and *Halysia 18-guttata*. (Proc. Ent. Soc., Lond., 1909, p. xxxiii.)

THE HOPE LIBRARY.

The accessions during 1909 were far more numerous than those of any recent year; and a large proportion of Miss Shelford's time was expended upon them. The fine series of books, separata, and journals from the Pascoe Library, presented by Miss Pascoe, is especially important.

DONATIONS.

The following publications and Reports were presented:—

Bombay Natural History Society: Journal, vol. xviii, pts. 4 and 5; xix, 1 and 2.

Boston Society of Natural History: Proceedings, vol. xxxiv (1908).

British East Africa. Department of Agriculture: Annual Report, 1908-9.

British Museum, Trustees of the:—

Sir G. F. Hampson, Bart.: Catalogue of Lepidoptera Phalaenae, vols. vii and viii.

E. E. Austen: Illustrations of African Blood-Sucking Flies other than Mosquitoes and Tsetse-Flies.

Cambridge University: Forty-third Annual Report for 1908 of the Museum and Lecture-rooms Syndicate.

Cold Spring Harbor Monograph (1909), vii.

Colonial Office, The:—

F. V. Theobald: Description of the new Mosquitoes collected by Dr. Graham in Ashanti (1909).

Papers on Tropical Medicine: A Suggestion for the Extermination of Sleeping Sickness in Africa, by H. I. Perkins (1909).

Investigation of the Bacteriological Laboratory, Réduit. Communication upon the presence of a parasite of the species Flagellata in the juice of certain herbs of the Spurge Family (*Euphorbiaceae*) (1909), by A. Lafont.

Cornell University Library: Librarian's Report, 1907-8.

Indian Museum, Calcutta: Report for 1907-8.

Records, vol. ii, pts. 2-5. Memoirs, vol. 1, pt. 3, 1908.

Illustrations of the Zoology of the Royal Indian Marine Ship *Investigator*, under the command of Captain W. G. Beauchamp, R.I.M. Crustacea, Entomostraca, &c., by N. Annandale and R. E. Lloyd. (1908).

London: Reports to the Local Government Board on Public Health and Medical Subjects: New Series, No. 5 (1909).

Michigan Academy of Science: Report, 1908.

New York State Museum: Sixtieth Annual Report and Sixty-first, pts. 1-3.

New South Wales Department of Agriculture: Report on Fruit Fly and other Pests, &c., by W. W. Froggart.

Otago University Museum: Report, 1908-9.

Ottawa Experimental Farms: Report 1906, and evidence of progress of agriculture in 1906-7.

Owens College: Report of the Manchester Museum, 1908-9.

Radcliffe Library: Catalogue of Books added to the Library in 1908.

Scotland, Marine Biological Station of the West of: Report for 1908.

Smithsonian Institution, Washington: Memoirs on Insects and Crustacea by the following authors:—F. E. Blaisdell, N. Banks, R. S. Bassler, T. D. A. Cockerell, H. Coutière, M. E. Gay, S. J. Holmes, H. A. Pilsbry, Harriet Richardson, J. A. G. Rehn, R. W. Sharpe, R. E. Snodgrass, E. O. Ulrich, and C. B. Wilson.

S. African Central Locust Bureau, Committee of Control:
Third Annual Report, by C. P. Loumsburg.

United States, Department of Agriculture: Bureau of
Entomology, Washington; Nineteen bulletins on
Economic Entomology by various authors; three
monthly lists of Publications issued by the Depart-
ment; Report of the Entomologist for 1908, by
Dr. L. O. Howard.

United States National Museum, Washington: Annual
Report for 1907-8.

The following authors have presented their publications to
the Library:—

Señor Don Ignacio Bolivar: Nine Treatises on Orthoptera.
Malcolm Burr, D.Sc., F.G.S., F.L.S., F.E.S.: Nine memoirs
on *Forficulidae*, and a paper on Orthoptera by A. M.
Shuguroff.

Philip P. Calvert, Ph.D., Assistant Professor of Zoology,
University of Pennsylvania, Philadelphia, Pa.: Three memoirs
on Neuroptera. (Central American Odonata.)

W. E. Collinge, M.Sc., F.L.S., F.E.S.: Observations on
Thereva mobilitata, &c., and in collaboration with J. W. Shoe-
botham, N.D.A., four papers on the Collembola.

The Director of the Laboratoire d'Études de la Soie, Lyon:
One paper on silk-producing Lepidoptera, by A. Conte.

Rev. Canon W. W. Fowler, D.Sc., M.A., &c.: "Genera
Insectorum," Fasc. 78. Fam. *Erotylidae*, sub-fam. *Languriinae*.

Canon Fowler also presented the Supplement of Rhynchota:
Hemiptera-Homoptera, vol. II of "Biologia Centrali-Ameri-
cana," thus completing the generous gift of the author's con-
tributions to this fine monograph.

C. J. Gahan: Thirty-six memoirs on Coleoptera, one written
in collaboration with G. J. Arrow, and one with G. J. Arrow
and C. O. Waterhouse.

Dr. R. Gestro, of the Genoa Museum: Twenty-five memoirs
on Coleoptera.

C. C. Gowdey, B.Sc., Government Entomologist, Entebbe,
Uganda: Three papers on Economic Entomology.

Dr. W. M. Graham: Report upon Entomological Observations made in Southern and Central Ashanti, 1907.

Dr. Achille Griffini, of the Royal Technical Institute of Genoa: sixteen memoirs on Orthoptera, chiefly the genus *Gryllacris*.

C. Gordon Hewitt, M.Sc.: five memoirs on bionomic and economic entomology.

Edmund Otis Hovey: The Bicentenary of the Birth of Carolus Linnaeus.

Charles Janet: Four memoirs on the structure of winged ants.

Chancey Juday, of Wisconsin Geological and Nat. Hist. Survey: Treatise on the food of Trouts.

Dr. H. Karny, of Vienna: four memoirs, chiefly on the Orthoptera.

Professor George H. F. Nuttall, M.D., Ph.D., Sc.D., F.R.S.: two treatises on Arachnida (Ixodoidea); three in conjunction with W. F. Cooper, B.A., and L. E. Robinson, A.R.C.Sc., and one in conjunction with C. Warburton, F.Z.S.

A. Patience: four memoirs on Isopod Crustacea.

Dr. J. A. G. Rehn: eight memoirs on Orthoptera, two written in conjunction with Morgan Hebard.

H. Schouteden, Docteur en Sciences naturelles, Secrétaire de la Soc. Entom. de Belgique: One treatise on Hemiptera (*Pentatomidae*) in Ann. Mus. Congo Belg. Zool. Ser. 3. I.

W. Schultze, Entomological Section, Biological Lab. Bureau of Science, Manila, P. I.: Five treatises on Insects of various orders.

Dr. Angelo Senna, of Florence: Twenty-nine memoirs on Coleoptera (*Brenthidae*).

Dr. David Sharp, of Cambridge: Fifty-nine memoirs on Coleoptera; two memoirs on Hemiptera; one memoir on Diptera; five memoirs on general subjects.

R. Shelford, M.A., F.L.S.: five memoirs on Orthoptera (*Blattidae*).

Professor W. M. Wheeler, of Harvard University: five memoirs on ants or the species associated with them.

The fine series of separata presented by Mr. C. J. Gahan, Dr. R. Gestro, Dr. Angelo Senna, and Dr. David Sharp were

given with the generous intention of completing as far as possible the sets in the Pascoe Library. A few publications, of which Dr. Gestro does not possess spare copies, have been purchased from a dealer in scientific papers.

Original papers have been presented by the following authors:—N. Annandale, in conjunction with Dr. Walther Horn of Berlin; E. E. Austen, F.Z.S. (two memoirs); F. Balfour-Browne, M.A. (Oxon.), F.R.S.E., F.Z.S.; Professor T. Hudson Beare, B.Sc., F.R.S.E., F.E.S.; M. le Vicomte R. du Buysson; Dr. J. Carl, of Geneva Museum (two memoirs); Dr. A. N. Caudell; G. H. Carpenter and I. Swain; Dr. T. A. Chapman; Cyrus R. Crosby, Esq.; H. Hamilton Druce, F.L.S., F.Z.S. (two memoirs); Richard Ebner; Dr. Günther Enderlein, of Stettin (three memoirs); H. Federley; T. Bainbrigge Fletcher, R.N.; A. E. Gibbs, F.L.S.; Dr. Ermanno Giglio-Tos; E. E. Green; A. H. Hamm (three memoirs); Professor Dr. F. Hermann, of Erlangen; G. W. Kirkaldy; Wm. S. Marshall; O. M. Reuter; C. Schaeffer; Dr. Chr. Schröder (Schöneburg-Berlin); A. Schultze; Rev. T. R. R. Stebbing, M.A., F.R.S.; F. Creighton Wellman, M.D. (two memoirs, one in conjunction with Dr. W. Horn); and F. Zacher, Dr. Phil., Breslau (two memoirs).

Valuable additions to the Library have been presented by the following donors:—

Dr. F. D. Godman, D.C.L., F.R.S., &c. : *Biologia Centrali-Americana*; *Insecta*; *Rhynchota*; *Hemiptera-Heteroptera*, Vols. I and II, 1880–1901, by W. L. Distant and G. C. Champion. *Hemiptera-Homoptera*: Parts in Vols. I and II, 1880–1909, by T. D. A. Cockerell and W. L. Distant. Dr. Godman's and Canon W. W. Fowler's generous gifts have completed these important monographs on the *Rhynchota* of Central America, which have now been bound and form a very valuable addition to the Hope Library.

Dr. W. Hoey, Hon. M.A., Jesus College: 1. *Journal of the Asiatic Society of Bengal*, N.S., XLII–LXVIII, 1873–99. 2. *Journal and Proceedings of the same Society*, 1905, 1906, 1907. 3. *Descriptions of new Indian Lepidopterous Insects*

from the collection of the late W. S. Atkinson, by W. C. Hewitson and F. Moore, Parts I and II, 1879-1882.

Dr. G. B. Longstaff, M.A., D.M., New College, F.R.C.P. &c. : Diary of a Naturalist, by J. W. Craig.

Mrs. A. T. Mundy : A monograph on the Anatomy, Habits, and Psychology of *Chironomus pusio*, Meigen, &c., 1880-1908, by the late A. T. Mundy.

G. A. James Rothney, F.E.S. : Transactions of the Entomological Society, London, for 1907.

Hon. Walter Rothschild, Ph.D. : The parts of the Novitates Zoologicae of the Tring Zoological Museum, published in the year 1909.

R. Shelford, M.A., F.L.S. : Obituary notice of Giuseppe Nobili by Prof. Lor. Camerano, one memoir on Crustacea by J. C. Bradley, and Fauna Hawaiiensis III. 4. Coleoptera III, by Dr. David Sharp, F.R.S., and Hugh Scott.

Colonel J. W. Verbury : Three memoirs on Diptera by F. M. Van der Wulp, and one by J. Aldrich and L. A. Turley.

The Professor :

Descriptive Catalogue of the Coleoptera of South Africa, by L. Péringuey, Vol. I, Part 1.

Vol. V. British Flies, by G. H. Verrall.

Revision of the Attidae of North America, by G. W. and E. G. Peckham.

Études de Lépidoptérologie comparée, III, by C. Oberthur.

Katalog der Staphyliniden-Gattungen etc., by F. Eichelbaum ; Revision des Prionides, by A. Lameere.

The publications of the Société Entomologique de France for 1909, and of the Société Entomologique de Belgique for 1909, the publications of the Linnean Society for 1909, the Transactions of the Entomological Society of London for 1908 and 1909, the fourth Annual Report of the Association of Economic Biologists, Boletín VIII, 1908, Estatutos, 1903, Reglamentos, 1906, and Vol. V of the Memorias de la Real Sociedad Española de Historia Natural of Spain were also presented by the Professor.

PASCOE ZOOLOGICAL LIBRARY.

Zoological works from the F. P. Pascoe library, presented by Miss Pascoe. This donation is the most important accession received by the Hope Library in recent years. The circumstances under which this valuable gift was made have been explained on p. 3. The following is a short summary of the accessions:—

Books, 87 in 121 volumes, exclusive of journals.

Separata, 256, including unbound catalogues and parts greatly wanted to make up imperfect sets of journals already in the Library.

A few examples have been selected to show the wide range of subjects covered by the volumes. It will be noted that some of them are the rare first editions of remarkable works.

André, E.: *Species des Hyménoptères d'Europe et d'Algérie*, I–VI, 1879–1891.

Bates, H. W.: *The Naturalist on the River Amazons*, I and II, 1863.

Belt, T.: *The Naturalist in Nicaragua*, 1874. A fine copy of the rare first edition of both these celebrated works.

Darwin, C.: 1. *On the Origin of Species by means of Natural Selection*. A fine copy of the original edition sold out on the day of issue, Nov. 24, 1859. 2. *Journal of Researches into the Natural History and Geology of the Countries visited during the voyage of H.M.S. Beagle round the World, under the command of Capt. FitzRoy, R.N.*, 1849. 3. *On the Structure and Distribution of Coral Reefs*; also geological observations on the Volcanic Islands and parts of S. America visited during the Voyage of H.M.S. *Beagle*, 1890.

Gemminger and Harold, B. de: *Catalogus Coleopterorum hucusque descriptorum synonymicus et systematicus*, I–XII, 1868–1876. A duplicate of Vol. VIII with many of Mr. Pascoe's notes is also included.

Gosse, P. H.: *Omphalos: an attempt to untie the geological knot*, 1857.

Hooker, J. D.: *Himalayan Journals*, I and II. New edition, 1855.

Jacquelin du Val, C.: *Manuel Entomologique. Genera des Coléoptères d'Europe, comprenant leur classification en familles naturelles, &c., et le Catalogue de toutes les espèces et plus de 1300 types dessinés par J. Migneaux, I-IV, 1857-1868.*

Standinger, O. and Wocke: *Catalog der Lepidopteren Europa's und der angrenzenden Länder. Macrolepidoptera. Microlepidoptera, 1861.*

Thomson, J.: *Systema Cérámbycidarum ou exposé de tous les genres compris dans la famille des Cérámbycides et Familles Limitrophes, 1864. Coleoptera Scandinaviae, eller Skandnaviens Coleoptera, I-X, 1859-1868.*

Wallace, A. R.: *The Malay Archipelago, &c., I, II, 1869.*

One of the works mentioned above, Gemminger and Harold's *Catalogue of Beetles*, is so essential that the Radcliffe Library copy held a nearly permanent place in the Department.

The separata include long series of valuable papers by the following authors:—F. P. Pascoe, Van der Poll, W. Roelofs, E. Reitter, J. Faust, A. Duvivier, Desbrochers des Loges, P. Bargagli, C. J. Gahan, C. O. Waterhouse, D. Sharp, H. W. Bates, R. Gestro, H. Lucas, A. Lameere, J. L. Leconte, A. Preudhomme, de Borre, F. W. Mäklin, A. Chevrolat, Adam White, R. McLachlan, A. R. Wallace.

In addition to the books and pamphlets already mentioned, there are eleven volumes of the Ray Society Publications, the most important being:—*A History of the Spiders of Great Britain and Ireland. Pt. 1, by J. Blackwall.*

The additions to the Journals of the Hope Library are especially important, the principal being *Annals and Magazines of Natural History* (helping to complete an imperfect set), third series, x-xx; fourth and fifth series, i-xx; sixth series, i-xii.

Numbers of the Publications of the Boston Natural History Society, Linnean Society, London, and the Zoological Society were also very valuable in filling up gaps in the existing series. The Volumes I-X of L'Abeille are an important addition to the journals, while there are also many single numbers of entomological publications of great interest.

The titles of the volumes, separata, and journals included in Miss Pascoe's generous gift to the Hope Library occupy 33 closely written foolscap pages of the Catalogue of Additions.

EXCHANGES.

The following were received in exchange for the Hope Reports:—

Deutsche Entomologische Zeitschrift for 1908.

Entomologisk Tidskrift, Stockholm, vol. xxix (1908).

Bulletin de la Société Entomologique Suisse, vol. xi, pts. 9, 10.

PURCHASES.

The following publications of the year 1909 were purchased for the Department:—The volume of the Zoological Record, the numbers of the Entomologist's Monthly Magazine, the Entomologist, and the Entomologist's Record.

In addition to the above—the normal expenditure for many years—the following purchases were made:—

Revisio Conocephalidarum, Jena, 1907, by Dr. H. Karny.

La Faune Entomologique du Delagoa. Orthoptères, by Dr. A. v. Schulthess of Zurich.

The Genitalia of the British Noctuidae, by F. N. Pierce, F.E.S.

Trois Orthoptères nouveaux du Congo français, par l'Abbé J. Dominique.

Notas Zoológicas, XIV, Neuropteros y Ortopteros nuevos de Aragon, by R. P. Longinos Navás, S.J.

Notes Orthoptérologiques, I–IV, by J. Pantel.

Two treatises on Orthoptera by Dr. Achille Griffini.

Five treatises on Coleoptera by R. Gestro; to complete the series of "Materiali per lo Studio delle Hispidae."

A treatise on Coleoptera by Dr. Angelo Senna; to complete a series.

E. B. POULTON.

Report of the Hope Professor of Zoology, 1910.

The following pages will indicate that 1910 was exceptionally important in the growth of the collections and the accumulation of material bearing upon the problems which have, for many years, been especially studied in Oxford.

There has been unfortunate delay in preparing the southern end of the Old Radcliffe Library for the reception of a part of the collection, and the congestion and inconvenience have been very great. There can be no doubt, however, that the additional space will be occupied and the collections arranged in it before the end of the present year.

Mr. R. Shelford's long illness and absence from Oxford have brought the working out of the Orthoptera to a standstill, and in many other respects he has been greatly missed. Mr. Shelford has, however, undertaken other valuable work which could be sent to him from time to time. The library has also suffered much from Miss Shelford's inability to continue her work.

1. *The Rothney Collection and Library of Oriental and British Hymenoptera, &c.*

This splendid donation, one of the finest received since the Department came into existence, arrived in perfect condition, with no single insect displaced—a result due to the complete and careful arrangements made by the generous donor, Mr. G. A. James Rothney, F.E.S., who himself superintended the loading of the van and bore the whole of the cost.

The collection consists of the following:—

(1) A fine 40-drawer cabinet nearly full of Oriental Hymenoptera, and extremely rich in types. The specimens collected by the donor in Barrackpore Park, Calcutta, Mussoorie, Allahabad, N.W.P., &c., are in very fine condition, and there are also series collected by Col. C. T. Bingham, and specimens from the collections of B. Cameron, Forel, and F. Smith. A large collection made by natives in the Khasia Hills, Assam, is very rich in types of new species not only among

the Aculeate Hymenoptera but also in the Phytophaga and the Parasitica. Special parts of the collection illustrate the habits and life-history of ants, and the mimicry of ants and of other Aculeate Hymenoptera. In addition to the Oriental material, ants from many other parts of the world are included in the collection.

(2) A 12-drawer cabinet containing English Aculeate Hymenoptera all in very fine condition. The collection contains the first male and female specimens of *Formica exsecta* taken in Britain, the example, until recently unique, of *Odynerus herrichii* (= *basalis*), Dorset, 1868, and many rare species.

(3) A large number of boxes containing Oriental insects of various orders, and one box of South American Hymenoptera. The Lepidoptera and Odonata (Dragon-flies) captured by the donor in Barrackpore Park are in very fine condition. Many of the latter series of Lepidoptera were contained in the last drawers of cabinet (1), but they have now, with the consent of the donor, been removed in order to be fully labelled and incorporated in the general collection. Their place in the cabinet is in part taken by Hymenoptera previously stored in unsafe "cartons," the majority forming a Javan collection presented by Mr. Rothney in the present year.

(4) Ninety-two volumes and a large number of unbound papers, of which the great majority deal with the Hymenoptera, and many with the material of the Rothney collection. See pp. 30, 31 for a further account of the books, &c., added to the Hope Library.

2. Work done by the Staff.

Mr. W. Holland, in addition to the periodical incorporation of specimens in the collections of various groups of insects, undertook the following important pieces of work:—the arrangement, verification of names, and classification of data of the 6,000 butterflies—chiefly Malayan—from the Van der Poll collection; the preliminary arrangement of several of the earlier families of moths; the re-arrangement of the large

collection of butterflies of the Nymphaline genus *Charaxes*: the mending, cleaning, and arrangement in 38 drawers of the Chevrolat *Carabidae*, from the Van der Poll collection. This last piece of work was especially heavy and of the utmost necessity, for the beetles when purchased were still contained in the original "cartons," with loosely fitting covers. The collection had been exposed to damp, and large numbers of specimens were covered with mould.

Mr. A. H. Hamm has assisted in the incorporation of Hymenoptera and Diptera, and has printed many large batches of labels, those for the Neave collection being the most important. His chief work, however, has been concerned with the fresh accessions as they came in, and especially with the consignment of Mr. W. A. Lamborn from the Lagos district. All of these were at once dealt with, so that they could be studied and the generous donor informed of the results without delay. Other donations which have occupied a large part of Mr. Hamm's time were those presented by Dr. G. B. Longstaff, Mr. F. C. Woodforde, Mr. C. A. Wiggins, the Rev. K. St. Aubyn Rogers, and Dr. R. E. Kunzé. He has also continued the readjustment of the specimens in the general collection of butterflies. This great piece of work will be completed in the present year.

Mr. Joseph Collins has continued the staging of the most delicate insects in the Dale Collection, completing the Hymenoptera Aculeata, Phytophaga, and Parasitica (begun in 1909). His most considerable work was the remounting and arrangement in 30 drawers of the second half of the British *Carabidae*, including about 4,000 specimens presented by Mr. W. Holland. He has also, with other smaller pieces of work, staged the 5-6,000 specimens—the material of the great Mendelian experiment—presented in 1909 by Mr. L. B. Prout, F.E.S., and Mr. A. Bacot, F.E.S.; labelled the large Atkinson Collection (chiefly Rhynchota) purchased many years ago; printed specific determinations and type and co-type labels for large numbers of specimens: labelled, in large part printed for, and numbered the accessions recorded in the later pages of this Report.

3. *Work on the Collections of Orthoptera.*

The state of Mr. Shelford's health entirely prevented him from coming to the Department last year, and from March 15, 1910, to April 11, 1911, he was absent from Oxford. He was able to write and publish one paper on *Blattidae*, to help in cataloguing the library accessions, and in entering up the catalogue of insect accessions—a laborious piece of work which was greatly needed.

4. *Work on the Collection of Picrinæ.*

Dr. F. A. Dixey has been engaged in incorporating *Picrinæ* from the collections presented by Dr. G. B. Longstaff, Mr. Neave, and Mr. Herbert Druce. This has involved a good deal of rearrangement of the group, which now occupies 380 cabinet drawers. He has also, in continuation of his work on the scent-producing apparatus in butterflies, devoted special attention to those genera of *Picrinæ* which are not furnished with plume-scales, particularly to the genus *Dismorphia*, in which the patches of specialized scales concerned in the function of scent-distribution are of a peculiarly interesting character. Many preparations of these have been made, and the results are being got ready for publication.

5. *Rearrangement of the British Beetles.*

The rearrangement of the British *Staphylinidae* has been most kindly continued by Commander J. J. Walker throughout the past year, and now approaches completion. The carded examples have almost without exception made excellent specimens when cleaned and freshly mounted; but a very large proportion of the *Staphylinidae* are, according to the practice of the early part of the last century, mounted on pins of a size and make quite unsuitable for these delicate and fragile beetles. The specimens bearing Haworth's labels, and the series in Prof. Westwood's Collection, named (*circa* 1845) by Mr. F. W. Holme, are of especial interest, for they record the names given by the older naturalists. These have been retained upon the original pins, but have been carefully

cleaned and mounted on card "stages." In their present state most of them make at least presentable specimens.

The whole of the British *Carabidae* have now been arranged in 60 drawers, the earlier half in 1907, the later in 1910.

The University is deeply indebted to Mr. Holland for the gift of his very fine collection—of especial interest as coming in chief part from the Oxford and the adjoining Reading district; to Mr. Donisthorpe for examples of a very large proportion of the known British *Carabidae*, the rarest and most local forms no less than the well known; to Commander Walker for superintending the re-arrangement and himself manipulating the most delicate of the old Hope-Westwood specimens; and to Mr. Collins for the care with which he has re-arranged the collection and borne so large a part in the manipulation.

6. *Work upon the Burchell Collections.*

The manuscript of Mr. E. G. Joseph's work upon the Heliconine butterflies collected by W. J. Burchell in Brazil (1825-30) was completed by the end of 1909, but the paper was not published until April 1910 in *Ann. Mag. Nat. Hist.* (p. 322). Mr. Joseph then worked upon the Brazilian *Acracinae*, and later upon the *Erycinidae*. The paper on the former group was published in the same journal (p. 9) early in the present year.

The Professor took the opportunity afforded by the meeting of the Entomological Congress at Brussels to submit the whole of the Coprid beetles collected in South Africa (1810-15) to Professor J. J. E. Gillet of Nivelles. This eminent authority kindly completed his examination in time for the Professor to bring the collection back to England. Many important modifications in the previous determinations were made by Professor Gillet.

7. *Assistance in Working out the Material of the Department.*

The kind assistance received in 1910 is, in large part, acknowledged in other sections of this Report. I desire here to acknowledge the generous and efficient help of the

Members of the Staff in the Insect Department of the British Museum of Natural History, of Mr. Hamilton Druce, and Mr. G. T. Bethune-Baker. Dr. Karl Jordan kindly examined at Tring and determined the Papilios of two important African groups, that of *P. menestheus* and of *P. nireus*, the specific distinctions in the latter being peculiarly difficult.

8. *Visits of Naturalists.*

The annual gathering of entomologists took place July 2-4, when the following Officers and Members of the Council of the Entomological Society of London were present:—Dr. F. A. Dixey, President; Mr. G. T. Bethune-Baker, Vice-President; Commander J. J. Walker, Secretary; Dr. Malcolm Burr, Mr. H. St. J. Donisthorpe, Mr. A. Harrison, Professor Selwyn Image, Dr. Karl Jordan, Mr. Hugh Main, and Mr. J. W. Tutt. The party also included Mr. W. Borrer, a member of the Entomological Club, and the following Fellows of the Entomological Society:—Mr. J. E. Collin, Mr. H. Eltringham, Dr. G. B. Longstaff, Mr. Guy Marshall, Mr. G. H. Verrall, and Col. J. W. Yerbury. The presence of so many eminent authorities was, as in previous years, of great advantage to the collections. It was furthermore a great pleasure to have the presence of so many naturalists who have generously assisted the University Collections. On other occasions in the year the Department has been visited by the following kind friends:—Mr. G. C. Champion; Mr. J. A. Cremer, of Zomba; Mr. W. J. Lucas; Mr. Guy Marshall; Mr. H. C. Robinson, Curator of the Selangor State Museum, Kuala Lumpur Museum, Federated Malay States; Mr. J. R. le B. Tomlin; and Mr. O. F. Watkins, of the British East African Protectorate. Before his return to Southern Nigeria, Mr. W. A. Lamborn studied in the Department some of the most important problems concerning the butterflies of West Africa (see pp. 16, 18).

Dr. G. B. Longstaff visited the Department many times in order to work out his fine collection of New Zealand insects, and, towards the end of the year, to study the

material described and figured in a comprehensive account of his observations about to be published.

Mr. W. B. Alexander, King's College, Cambridge, visited the Department in order to study the material of the Prout-Bacot Mendelian experiment on *Acidalia virgularia*. Professor Joseph J. E. Gillet of Nivelles kindly undertook, Sept. 22-28, a preliminary revision of the group of beetles in which he is so distinguished an authority, the *Copridae*. An important section of the family has since been sent to him for detailed study. Dr. R. Hanitsch, of the Raffles Museum, Singapore, has studied the Orthoptera, Mr. L. B. Prout the Geometrid moths, and Mr. Roger Verity, of Florence, the butterflies of the genus *Parnassius*. Mr. F. C. Woodforde, B.A., paid many visits to the Department, studying the British Lepidoptera, and suggesting necessary modifications. He also kindly assisted the Professor in arranging and checking the lists of the books and papers presented by Mr. G. A. J. Rothney, as well as other accessions to the Hope Library.

The Department was also visited by Professor F. Jeffrey Bell, M.A., Magdalen; Dr. Henry Bolus, of Kenilworth, near Cape Town; Prof. W. Haswell, F.R.S., of Sydney; and Prof. Adam Sedgwick, F.R.S.

9. Works published in 1910.

Mr. H. Eltringham completed the preparation of his important monograph, *African Mimetic Butterflies*, which was published by the Clarendon Press in the summer in time for the meeting of the first International Entomological Congress at Brussels. He also investigated the geographical distribution and relationships of two African Acracine butterflies, *A. lycoa* and *A. johnstoni*, and completed a paper with two plates thereon, to be issued almost immediately by the Entomological Society of London. Mr. Eltringham then began to prepare a monograph on the whole of the Ethiopian species of *Acracinae*, a work which is still proceeding. In the course of last year about 250 preparations of genitalia have been made and studied. Mr. Eltringham has not only examined the material in the Department, but that in the

British Museum and the Tring Museum. In the latter collection he has made a preliminary arrangement of the whole of the African Acraeas.

The state of Mr. R. Shelford's health only permitted him to write a single paper published in the course of 1910:—"A new cavernicolous cockroach" (*Ann. Mag. Nat. Hist.*), but the following memoirs written by him in 1909 appeared in the year now under review:—

GENERA INSECTORUM. *Blattidae*, sub-fam. *Epilamprinae*.
ditto ditto sub-fam. *Blattinae*.

On a collection of *Blattidae* preserved in amber from East Prussia. *J. Linn. Soc., Zool.* xxx, 1910 (p. 336).

Blattidae collected by Prof. W. Kükenthal in West Indies. *Zool. Jahrb., Suppl.* 11, Heft 2, 1910 (p. 105).

The following memoir also deals with the collections of Orthoptera:—

Third paper on the *Tetriginae* (*Orthoptera*) in the Oxford University Museum, by J. L. Hancock, M.D., F.E.S. *Trans. Ent. Soc. Lond.* 1910 (p. 346).

The following short papers have appeared in the *Entomologist's Monthly Magazine* for 1910 (second series, vol. xxi):

A new aberration of *Ephyra pendularia*, L., by F. C. Woodforde, B.A., F.E.S. (p. 144).

Notes on *Cetonia aurata*, L., and *C. floricola*, Herbst., by A. H. Hamm (p. 137).

Some Notes on the Lepidoptera of the "Dale Collection," now in the Oxford University Museum. Concluded. PYRALIDINA (including DELTOIDES), by Commander J. J. Walker (p. 185).

The following short papers, or brief descriptions of the material of the Department exhibited at the meetings of the Entomological Society of London in 1910, have been published in the Proceedings:—

Jan. 19, 1910, p. lxxxvii of the Proceedings for 1909. The Plume Scales of the *Pierinae*. The Presidential Address

read before the Entomological Society of London at the Annual Meeting, by Dr. F. A. Dixey.

March 2, p. xiv, Proceedings, 1910. Preliminary note on Mr. A. D. Millar's experimental breeding of forms of the Nymphaline genus *Euralia* in Natal, by the Professor.

March 2, p. xvii. The female of *Apaturopsis cleocharis*, Hew., taken by C. F. M. Swynnerton in S.E. Rhodesia, by the Professor.

May 4, p. xxxi. The Edibility of Lepidopterous Larvae, by H. Eltringham.

June 1, p. xli. The correction of an error in the account of the breeding of *Charaxes zoolina neanthes*, by the Professor.

An account of other work carried on in 1910. but unpublished in that year, will appear in the Report of 1911. The work on the Burchell Collections appears on p. 5 under a separate heading.

10. *The First International Entomological Congress.*

The first meeting of the Congress, held at Brussels during the first week of August, was very largely attended by British entomologists, including several naturalists who have associated themselves with the Hope Department. The Professor, with the kind help of Mr. H. Eltringham, conveyed the examples of three series of mimetic butterflies, collected near Entebbe from May 23 to September 30, 1909, by Mr. C. A. Wiggins. The combinations, ranged round three types of *Planema* (*Acraeinae*) pattern, occupied, together with the models, 11 large store-boxes. The whole had been provided by Mr. A. H. Hamm with printed labels, giving the names of the species and the dates on which they were captured. The *Planema* models were rendered conspicuous by red labels as well as by their position. The whole collection was carried to Brussels and back without injury. A memoir on the exhibited specimens will appear in the Report of the Congress.

The large attendance of British naturalists was recognized in the unanimous choice of Oxford as the home of the second Congress, to be held in 1912.

II. *Seventh Volume of Hope Reports.*

The seventh volume, issued at midsummer, contains reprints of 37 octavo memoirs which have appeared in the two years between June 1908 and June 1910. But for the pressure of work it would have been issued at an earlier date and in a less inconveniently bulky form. Many papers are already in hand for the eighth volume.

ADDITIONS TO THE COLLECTIONS IN 1906.

Nine butterflies from the Rio Huancamayo, Carabaya, East Peru (2,000 ft.), collected by G. R. Ockenden (1904), were presented by Herbert Druce, Esq., F.L.S., &c.

Five hundred and fifty-four Northern Rhodesian moths from the fine series collected in 1904-5, and presented by S. A. Neave, Esq., M.A., B.Sc., Magdalen College, have been catalogued and, with many hundreds of additional specimens, incorporated in the collection. Mr. Neave's moths have now been worked out by Sir George Hampson (Proc. Zool. Soc. 1910, pp. 388-510), and it was thought desirable not to incorporate the specimens until the specific determinations and reference to the memoir could be placed upon them. This has now been done, and the series is a most valuable addition to the University Collection. Many of the specimens are co-types of new species described by Sir George Hampson in the above-mentioned work. A full account of the localities was published in the Report of 1908.

ADDITIONS TO THE COLLECTIONS IN 1908.

A valuable series of *Asilidae* (Diptera) from the Bigot Collection (c. 1845-93), presented by G. H. Verrall, Esq., in 1908, has now been added to the general collection kindly arranged by Colonel J. W. Yerbury. This generous gift also included many *Asilidae* from other parts of the donor's collection. All the specimens have been supplied with printed labels clearly indicating their source.

Six hundred and eighty-eight moths—Geometers, Noctuas, Pyrales, and Micro-Lepidoptera—and one Phryganid, from the

Khasia Hills, Assam (c. 1904), presented by Herbert Druce, Esq., F.L.S., &c., have been catalogued and, with many others, incorporated. This is a further instalment of the splendid series from this interesting locality presented by the generous donor. Several instalments of equal or larger extent have been acknowledged in earlier Reports.

Sixty-eight insects of various groups and one Acarid, from Durban and Camperdown, Natal (1908), were presented by the captor, G. F. Leigh, Esq., F.E.S. Three sets of parasitic Hymenoptera, bred by the donor from the pupae of moths, 2 Hemiptera from ants' nests, and a Neuropterous insect allied to *Bittacus* with its Dipterous prey, are included.

ADDITIONS TO THE COLLECTIONS IN 1909.

Two hundred and seven insects of various groups from Durban and Pinetown (c. 1,000 ft.), Natal, were presented by the captor, G. F. Leigh, Esq., F.E.S. Included in the series are a *Salix* with its victim, a Lycosid spider, and two Asilid flies with their prey—a Pentatomid bug and a bee respectively. These will form an interesting addition to the bionomic collection.

The localities of the great collection made, Jan.-Sept., 1908, in N. Rhodesia, by S. A. Neave, Esq., M.A., B.Sc., Magdalen College, were fully described in the Report of the year 1909. The moths have now been worked out, together with those of Mr. Neave's earlier collections, by Sir George Hampson (see p. 10), and 380 have been catalogued and, with many hundred additional uncatalogued specimens, incorporated in the collection. With the exception of a few specimens which are still without their printed labels, the whole of the moths presented by the generous donor in 1906 and 1909 have now been incorporated, forming a splendid addition to the Ethiopian material which is so marked a feature of the Hope Department.

Sixteen males and two females of the little fritillary *Argynnis cytheris*, from the McClelland R., Tierra del Fuego (1904), were presented by the captor, Captain R. Crawshay. Three males and one female were added to a special faunistic

collection illustrating the northern affinities of the butterflies in the south temperate sub-region of South America.

The following valuable donation was presented by P. de la Garde, Esq. One hundred and sixty-one Rhynchota Hemiptera and Homoptera, captured in the following localities: S. Africa (1892-4) chiefly Simonstown, Zanzibar (1893), Rarotonga (1896), Fiji (1896), Sydney (1898), Hobart (1897), Queensland, Brazil (1900), Monte Video (1900). Two hundred Lepidoptera, chiefly butterflies, from a great variety of European localities (1890-1904), and 15 Lepidoptera from Asia Minor, &c. An example of *G. rapae*, the "Small Garden White," bred at Teignmouth (April 2, 1905) from a pupa imported with bananas from the Canary Islands. An ant from Monte Video.

In addition to the above, 6,000 butterflies, almost exclusively Malayan, and the Chevrolat Collection of *Carabidae*, both forming part of the Van der Poll Collection, were presented by the Professor in 1909.

ADDITIONS TO THE COLLECTIONS IN 1910.

Very fine accessions to the collection of Lepidoptera are due, as in previous years, to the generosity of Herbert Druce, Esq., F.L.S., F.E.S., &c. Specimens from the following localities have been incorporated:—

Khasia Hills, Assam, 543 moths—chiefly Geometers and Pyrales—and 3 Neuroptera. This series, of which 283 have been catalogued, completes the fine collection from the Khasia Hills, referred to above and in many earlier Reports.

Chanchamayo, Peru, 4 fine examples of the Syntomid moth *Isanthrene joda*, H. Druce.

Carabaya, Peru (G. R. Ockenden; various localities and dates), 531 moths (chiefly *Geometridae*) and 17 butterflies.

Upper Kassai River District, Congo State (Paul Landbeck), 287 butterflies and 40 insects of various groups. The butterflies include many *Lycaenidae* and *Hesperidae* especially wanted by the Department.

Bitje, Ja River, Cameroons (G. L. Bates, 1909), 321 moths,

25 butterflies, and 1 Homopteron. Also 9 butterflies from the Cameroons without further locality.

Accessions from these South American and West African localities are especially welcome to the Department.

A fine series of moths from the following American localities was presented by the captor, Commander J. J. Walker, Hon. M.A., F.L.S., F.E.S.:—

Callao, Peru (Mar. 31—July 17, 1881, and Dec. 13, 1882—Jan. 8, 1883), 117 specimens.

Callao, Peru, S. Lorenzo Island (Sept. 1–10, 1881), 5 specimens.

Valparaiso, Chile (1882–4), 45 specimens.

Coquimbo, „ („), 55 „

Talcahuano, „ (1884) 16 „

Arica, „ („) 10 „

Panama and Taboga Island (1882), 4 specimens.

Esquimalt, Vancouver Island (1882), 62 specimens.

Various localities and dates, 14 specimens.

The data are detailed and precise, and the whole a valuable addition to the general collection of moths.

Commander Walker also presented 33 Australian butterflies (*Hesperidae*), collected in various years in the Sydney district and named by G. A. Waterhouse, Esq. The specimens are a welcome addition to the rather poor collection of Australian “skippers” in the Department.

Six European beetles determined by Herr Formanek, 3 (from Sweden) by Dr. L. B. Ericson, and 4 (Loire-Inf.) by Monsieur H. St. Cl. Deville were presented by H. Donisthorpe, Esq., F.E.S.

A valuable series of 41 cocoons of Saturnian moths, partly bred in captivity and partly found wild in various localities, was presented by J. H. Watson, Esq.

Fifty-five butterflies and 209 moths from Cornwall and Staffordshire (1910), with 7 from other British localities, were presented by the captor, F. C. Woodforde, Esq., B.A., Exeter. This accession is in addition to the fine series presented by the same donor to the British Collections (see p. 22).

An interesting series of about 100 European Micro-

Lepidoptera, at one time part of the collection of the late Henry Doubleday, was presented by Mr. Joseph Collins. A list of names in Doubleday's handwriting gives an added interest to the donation.

Five moths and a Hesperid butterfly from localities of great interest in N. Kashmir (1909) were presented by the captor, Lieut. T. G. Longstaff. The Hesperid was from Chulung (14,800 ft.), Baltistan, Karakoram Mts. (July 11); 3 Geometrids from Upper Saltoro Valley (12,000 ft.: June 27); 2 Noctuids from Ladak (16,000 ft.: Aug. 16).

A series of 61 butterflies from British New Guinea was presented by S. A. Neave, Esq., M.A., B.Sc., Magdalen College. The specimens were given to him by G. T. Bethune-Baker, Esq., F.L.S., F.E.S., in exchange for N. Rhodesian butterflies. Nearly all the specimens were taken by the experienced collector A. E. Pratt, and the localities and dates are precise. The Department is very poor in material from this most interesting island, and the donation is correspondingly valuable.

Twenty Lepidoptera from Cooktown, N. Queensland (1897), 9 of uncertain locality, and 4 butterflies from Thursday Island (1897), were presented by P. de la Garde, Esq.

A fine set of 12 *Vanessa gonerilla*, "The New Zealand Admiral," from Christchurch (bred probably in 1909), was presented by F. S. Oliver, Esq.

Four examples of *D. strigosa*, the Arizona form of *Danais berenice*, and three of its mimic *Limenitis (Basilarchia) hulsti*, from Tucson (2,400 ft.), S. Arizona (1896), together with another example of *hulsti* from Phoenix (1,100 ft.), S. Arizona (1897), were presented by the Brooklyn Museum, N. Y. The specimens were captured by Dr. R. E. Kunzé, who has himself presented the very fine collection of insects mentioned on p. 20. All the mimetic N. American forms of *Limenitis* except *hulsti* have been studied in the Department (Trans. Ent. Soc., Lond., 1908, pp. 447-88), and it will be especially interesting to make a detailed examination of this remaining example. Such work can now be undertaken under very favourable circumstances, thanks to the kindness of Dr. Lucas, Curator of the Brooklyn Museum, and Dr. R. E. Kunzé, who

has since presented many further specimens of both model and mimic.

Forty-two Heliconine butterflies, including an example of the rare *H. nanna*, 7 *Papilioninae* and 3 *Nymphalinae* (*Kallima*), from various localities, were presented by the Hon. Walter Rothschild.

The accessions from the Ethiopian region form, as they have done for many years past, the most important additions to the University Collections.

A very fine series of 420 Lepidoptera, of which 182 have been catalogued and nearly the whole incorporated in the collection, was presented by the captor, W. A. Lamborn, Esq., M.R.C.S. The specimens were taken about 70 miles east of Lagos, at Oni, on the east shore of the Lekki Lagoon, about 10 miles from the sea. The elevation is low (0-100 ft.), and the country around covered with primitive forest with paths and native clearings. In Oni clearing and in the forest for 5 miles to the east of it the collection was made between Dec. 1, 1908, and Dec. 3, 1909. The most interesting specimen was a remarkable Lycaenid of a new genus and species since described as *Neaveia lamborni* of H. H. Druce. Many other *Lipteninae* (*Lycaenidae*) were greatly wanted by the Department. Among the *Nymphalinae* the fine *Neptis nebrodes* was new to the University Collection. The *Danainae* included a male example of *Amauris niatus* in which the scent-patch of the right hind-wing had been eaten by ants. Specimens from the West Coast of Africa with full and precise data have long been one of the chief needs of the Hope Department; so that this gift is of unusual value and importance. Since the donor's return to Oni early in the year he has continuously collected, observed, and recorded for the Department, and by the date of his return to this country at the end of April, 1911, had sent specimens occupying 100 cabinet drawers. A large part of the labelling has been done, but the cataloguing and incorporation cannot be finished in time for this Report. The observations will be published as an important memoir on the habits, &c. of West African Lepidoptera. A specially valuable part of the work results from the large amount of

breeding which the author has undertaken, and the volume of observations on the early stages of Lepidoptera which he has made.

Two of Mr. Lamborn's observations are so important and interesting that it is necessary to record them briefly without further delay. The first is one of the most striking examples of Protective Resemblance that has ever been discovered—the caterpillar of a Hypsid moth, *Deilemra antinorii*, which heaps upon its cocoon a mass of frothy spheres, possessing when dry an extraordinary likeness to the minute cocoons of parasitic Hymenoptera clustered around the dried body of their victim. The defence is doubtless against the Vertebrate enemies of the pupa. The second observation throws remarkable light on certain secondary sexual characters of male *Danainae*. These butterflies commonly possess a double tuft of hairs which can be protruded from the posterior extremity of the body, as well as "brands" or patches of peculiar scales on the wings. Both characters have been interpreted as scent-producing organs employed in courtship. The relationship between them, although suggested by Fritz Müller, has never until now been observed. In January of the present year Mr. Lamborn saw a male of *Amauris niavius* brushing the brands on its hind wings with the protruded tufts, as though some secretion was being conveyed from the one to the other. The greasy appearance of the brands may be probably interpreted on the hypothesis that they serve to retain and distribute the scent brought to them by the tufts.

In addition to the splendid donation from the Lagos district, 5 butterflies from Ladysmith, Natal (June, 1908), were presented by the captor, W. A. Lamborn, Esq.

A fine series of 196 Coleoptera and 6 Rhynchota from Brazzaville, French Congo (Aug.-Dec., 1909), together with 35 Coleoptera and 1 Hemipteron (Dec. 1909—Mar. 1910), were presented by H. Eltringham, Esq., M.A., New College. The series, of which nearly the whole is catalogued, includes a set of Lycid models and their Longicorn mimics, for the bionomic series.

Three examples of a beautiful Geometrid moth, *Zamarada*

rufilinearia, collected in Nyassaland by S. A. Neave, Esq., M.A., B.Sc., Magdalen College, were presented by the Entomological Research Committee of the Colonial Office.

Forty-three butterflies from the Wassaw District of the Gold Coast were presented by the Hon. Walter Rothschild.

Of great interest is an example of the female form *inaria* of *Hypolimnas misippus*, captured at sea (Jan. 19, 1910) 30 miles from land and 50 north of Mombasa, and presented by S. A. Neave, Esq. Thus further evidence of the wandering habits of this butterfly is added to that already in the Department.

A deeply interesting family of 11 butterflies bred from a female *Hypolimnas (Euralia) mima* was presented, together with 11 pupa-cases, by A. D. Millar, Esq., of Durban. The female parent, captured at Mount Edgumbe, near Durban, laid eggs Nov. 21, 1909: the offspring completed their life-history in a month or under, all emerging from the pupa Dec. 19-22. Eight of them, 5 male and 3 female, are *mima* like the parent, mimicking *Amauris echeria* and *albinaculata*. The remaining 3 are male examples of the butterfly previously known as *Euralia wahlbergi*, a mimic of *Amauris niavius dominicanus*. Indirect evidence that *mima* and *wahlbergi* may be the dimorphic forms of a single species was brought forward by Mr. Guy A. K. Marshall in 1902 (Trans. Ent. Soc., Lond., pp. 491-2). The paper is reprinted in Vol. III of Hope Reports, and it is of great interest that a part of the conclusive direct evidence obtained 7 years later should have found a place in the Department. Mr. Millar is to be warmly congratulated on his success in solving a most interesting problem. A full account of this and his other successful results with *Euralias* has been published in Trans. Ent. Soc., Lond., 1910, p. 500, by Roland Trimen, Esq., Hon. M.A., F.R.S.

In the 1902 memoir referred to above the Professor wrote on p. 492: "If Mr. Marshall's conclusion be established, it follows that the corresponding and closely-allied mimetic West African forms *Euralia anthedon* and *E. dubia*, connected like *wahlbergi* and *mima* by intermediate varieties, are similarly

the dimorphic forms of a single species." In a few weeks this question will also be settled by the arrival in Oxford of families bred from these two forms in the Lagos district by that most generous helper of the Department, Mr. W. A. Lamborn.

[Since the above paragraph was written, the question has been settled; for two families of known (female) parentage have been received from West Africa. The female parents were both forms of *E. dubia*, and yet *anthedon* is abundantly represented in both sets of offspring, each containing over 100 individuals. E. B. P., May 22, 1911.]

The great interest of Mr. Millar's discovery is that the dimorphism is unconnected with sex, males and females being equally present in both forms. Dimorphism or polymorphism in one sex, as in the females of *P. dardanus*, mentioned below, is well known. Dimorphism like that of the Euralias has hitherto been looked upon as exceedingly rare.

A beautiful pair of *Hypolimnias (Euralia) deceptor*, bred May 7-8, 1909, from eggs laid Mar. 24-5, was also presented by A. D. Millar, Esq. The female parent was captured at Mount Edgcumbe. The same generous donor has presented a fine series of bred *Pseudacraeas* and other Natal butterflies. These have received their printed labels, but have not yet been catalogued. They will be acknowledged in detail in next year's Report.

An extremely interesting family of *Papilio dardanus cenea* was purchased from Mr. G. F. Leigh, F.E.S. The female parent, of the relatively rare *trophonius* form, was captured June 26, 1910, at Pinetown, Natal (about 1,000 ft.), and laid 62 eggs on June 27 and 28. Mr. Leigh succeeded in breeding no less than 55 butterflies, all of which emerged from the pupa between Aug. 26 and Sept. 8, 1910. Of these 25 are males (non-mimetic) and 30 females, a result which supports the conclusion that the rarity of the females is only apparent and due to their retiring habits. Of the 30 females 22 are the *cenea* form, mimicking the commonest Danaine butterflies in Natal, *Amauris echeria* and *A. albimaculata*; 4 are *trophonius* like the female parent, mimicking the abundant Danaine

Danaida chrysippus; 2 are *hippocoön*, mimicking the conspicuous black and white Danaine *Amauris niavius dominicanus*; 2 are a remarkable unnamed form known to occur occasionally in Natal and evidently representing the *planemoides* form which, much further to the north, mimics the Acraeine butterflies *Planema poggei* and the male of *Pl. macarista*. But in the absence of the models, which do not come within many hundreds of miles of Pinetown, the pattern of the female form differs in many respects from that of true *planemoides*. Another very interesting feature in the family is the evident effect produced by the *trophonius* parent upon offspring belonging to a different form. Thus the pale hind-wing patch in several of the *cenca* females is of an unusual fulvous tint—a clear effect of the dominant colour of *trophonius*. This result compares in a most interesting manner with another family bred in 1906 by the same keen naturalist and also in the Hope Department. In this latter some of the *cenca* offspring similarly show the effect of the white in the hind wing of the *hippocoön* parent (Trans. Ent. Soc., Lond., 1908, p. 436). This recent accession is the most remarkable of the 7 families of *P. dardanus* in the Department.

In addition to the above accessions, a few others of great importance must be mentioned although not yet incorporated.

The Royal Museum of Natural History of Brussels presented a fine representative series of butterflies from the Congo State. The collection had been selected to exhibit to the King of the Belgians, and the specimens are beautiful examples of their species. They are a welcome addition to the African collection from a part of the continent that is but poorly represented here.

A great deal of time has been devoted to the wonderful mimetic series collected in 1909 and 1910 in the neighbourhood of Entebbe by C. A. Wiggins, Esq. (see p. 9). A great part of the setting and labelling has been done and it is hoped that, in collaboration with Mr. Wiggins, who is now in this country, the whole of the material may be studied and arranged in the course of the present year.

The generous help to the University Collections which has

been rendered for so many years by the Rev. K. St. Aubyn Rogers, M.A., Wadham, F.E.S., has been continued in 1910. The very interesting British East African butterflies, chiefly from the neighbourhood of Rabai, near Mombasa, sent by him in 1910 have, with few exceptions, received their printed labels. The amount of work that was necessary in preparation for the return of Mr. C. A. Wiggins and Mr. W. A. Lamborn prevented the final cataloguing and incorporation of these and many of the earlier series presented by the same kind donor; but all will be completed in the near future and a full account given in next year's Report.

Dr. R. E. Kunzé's valuable donation of insects of many groups from Arizona and of butterflies from California and the North Eastern States will also be dealt with at the earliest possible opportunity. All the specimens have been prepared, but the printed labels have not yet been supplied. Arizona, on the northern borders of the Neotropical Region, is an area of exceptional interest and specimens from it are correspondingly valuable to the student.

ADDITIONS TO THE BRITISH COLLECTIONS IN 1910.

The fine collection of British Rhynchota Hemiptera and Homoptera belonging to the late Edward Saunders, F.R.S., was presented by Dr. G. B. Longstaff and the Professor. This, one of the most important additions ever made to the British Collections in the Department, consisted of 17 boxes containing many thousands of specimens determined by this eminent authority in the group. The work upon this collection and its arrangement in cabinet-drawers fell into the present year and will be described in the next Report. It is a pleasure to Oxford zoologists and to the family of the late distinguished naturalist to know that the collection to which he devoted much time and thought is now beside the collections of his father and cousin in the Museum he was ever ready to help.

Another addition to the British Collections—also among the most important ever received—is due to the generosity of Mr. W. Holland, of the Hope Department, who, in 1907,

presented his fine collection of Carabid beetles. The first half of these, containing about 4,400 specimens, was incorporated in 1907 in the first 30 drawers of the rearranged collection of British beetles, and was acknowledged in the Report of that year. The remainder, including about 4,000 specimens, has been placed in the next series of 30 drawers containing the completion of the rearranged *Carabidae*.

Over 850 British flies, chiefly belonging to the family *Dolichopodidae*, but also including many much-needed representatives of several other groups, were presented by Col. J. W. Yerbury, late R.A., F.E.S., F.L.S., F.Z.S. All the species, the great majority of which are very difficult to determine, have been worked out by Mr. G. H. Verrall, Mr. J. E. Collin, and Col. Yerbury himself. The names have been printed and placed on all specimens, and 725 have been catalogued. The material of this most valuable donation was collected by the donor in South Wales (Porthcawl, June) in 1906, and in the following English localities in 1909:—

S. Devon, April (Torcross); Dorset, August (Studland); New Forest, September (Lyndhurst, Brockenhurst, and Holmsley); Cambridgeshire, May (Wood Ditton); Suffolk, May (Mildenhall and Tottington); Essex, July (Clacton-on-Sea, Kirby-le-Soken, and Walton-on-Naze); Kent, June (Dartford).

About 400 British Coleoptera, presented by H. St. J. K. Donisthorpe, Esq., in continuation of his generous gifts in earlier years, have been labelled and catalogued. They include an example of the rare Staphylinid beetle *Emus hirtus* (1910), a mimic of a humble-bee. The actual number catalogued is 380, but often 2 and sometimes 3 specimens on a single mount are included under the same number. Mr. Donisthorpe also presented 66 Rhynchota Hemiptera and Homoptera, and an interesting series of 27 insects of various groups, especially ants and other Hymenoptera, 4 examples illustrating the bionomic relations of insects, and 4 illustrating their means of dispersal in modern times. The latter includes a cockroach introduced in bananas, and beetles imported with plants into the Botanical Gardens at Kew and Dublin.

The specimens were captured by the donor chiefly in 1908 and 1909 in the following counties and districts:—

S. Devon, New Forest. Isle of Wight. Sussex, Kent, Berkshire, Surrey, Middlesex, Essex, Cambridge, Nottingham, Durham, Cumberland, Dumfries, and Inverness.

The British Collections, especially the Lepidoptera, have been greatly enriched during the past year by the kindness of F. C. Woodforde, Esq., B.A., Exeter, who has collected in several localities during 1910 and presented the following fine series of specimens with excellent data:—

From the Bude district, Cornwall (June–Sept.):—140 butterflies, including a fine series of “the Large Blue,” *P. arion*; 646 moths; an example of *Asilus crabroniformis* with its Dipterous prey, for the bionomic series.

From N. Wales (1908–10) and the following counties, &c.—Cornwall, Isle of Wight (1900), S. Devon (1897, 1910), Essex (1908), Huntingdon (1899, 1910), Oxfordshire, Staffordshire (1909–10), Shropshire, Cheshire (1908–9), Lancashire (1897, 1904), Westmoreland, Rosshire (1908):—22 butterflies, including 10 *Coenonympha rothliebii* (the “Marsh Ringlet”); 205 moths, including the following interesting Geometers—*Acidalia humiliata* (6), *Ephyra pendularia*, v. *subochreata* Woodforde (2, including the type of the var. described in E. M. M., 1910, p. 114), v. *subroscata* Woodforde (2), *O. bidentata* (2 melanistic vars.); and Noctuas—*Nonagria concolor* (4), *Caradrina ambigua* (7), *Epunda lutulenta* (1), *Dianthecia barrettii* (2), *Polia (nigrocincta) xanthomista* (2), *Acronycta leporina*, bred (2), *Dianthecia conspersa*, a bred series, *Agrotis ashworthii* (4); 13 Hymenoptera; 29 Diptera; 1 Hemipteron; 4 Neuroptera; 3 Orthoptera.

Some of the specimens in the above lists were captured or bred by friends of the donor, and many were bred by him. When no date is mentioned 1910 is to be understood.

Twenty-two Noctuid moths, including a series of *Orthosia suspecta*, from the neighbourhood of Market Drayton (Aug. 2, 1910) were presented by the captor, E. D. Bostock, Esq. Six specimens were added to the general and the remainder to the British collection.

Four examples, 2 males and 2 females, of the bee *Odynerus herrichii* (= *basalis*), from Swanage, June, 1908 and 1909, were presented by the captor, C. M. Mortimer, Esq. An account of this interesting re-discovery is published in the Ent. Monthly Mag., 1908, p. 236, and 1910, p. 1.

A fine series of two species of Phytophaga (Coleoptera) from the Oxford district was presented by the captor, Commander J. J. Walker, Hon. M.A.:—10 *Donacia dentata* on *Sagittaria sagittifolia* near the Wolvercote Paper Mill (July 17, 1909); and 19 *Chrysomela menthastri* on *Mentha* by the Wilts. and Berks. Canal, between Wantage Road and Abingdon (July 2, 1909).

Commander Walker also presented an example of *Vanessa urticae* from which the left hind wing was wanting. The specimen was bred (Oct. 28, 1909) from a larva found at Gosford, near Abingdon.

The voracity of the *Locustidae* is well illustrated by another donation of Commander Walker's—an example of *Thamnorrhiza cinerea* (Streatley, Sept. 3, 1910). This insect devoured its own left third leg which had become detached in the box.

A female *Gonepteryx rhamni*, "The Brimstone Butterfly," which had entered a room in No. 4 Norham Gardens, probably intending to hibernate, was captured, Oct. 25, 1909, and presented by H. S. T. Biscoe, Esq.

A large Acarid from the neck of a tortoise at Cambridge (June) was presented by J. E. Collin, Esq., F.E.S. In this and in succeeding donations when no year is mentioned, 1910 is to be understood.

An Ichneumonid from Swanage (August) was presented by the captor, the Rev. W. M. Merry, M.A., Lincoln.

Thirty-seven Coleoptera from Yarmouth, Norfolk (Aug., 1910), were presented by the captor, Mr. A. Cant, F.E.S. The specimens were beautifully mounted by the donor.

The Locustid *Meconema varium* captured in the Pitt-Rivers Department (Oct. 6) was presented by Mr. H. Waters.

Five *Ennomos alniaria*, from the Oxford district, bred in July and August, together with *Toxocampa pastinum* from Cothill (Aug. 7) were presented by Mr. A. H. Hamm.

Mr. J. Collins presented the following insects captured by him in the Oxford district:—

Two examples of *Microdon devius* from Cothill, near Abingdon (June, 1909 and June, 1910): this rare Dipterous insect is an addition to the Oxford district, and was wanting from the collection of British insects; a pair of *Simulium* sp. and of *Harpalus obscurus* from Enslow Bridge (May); 3 co-types of the minute beetle *Enicmus histrio*, described by Dr. Norman Joy in E. M. M., 1910, p. 250. Wytham (April 17), and from the same locality (May 29) 2 Telephorid beetles of different genera, *Telephorus pellucidus* and *Pedabus alpinus*, captured together by sweeping and exhibiting the close superficial resemblance—doubtless Müllerian in character—that is so well known in the family; the Syrphid fly *Chrysoclamys cuprea*, together with the puparium from which it was bred (July 21), Water Eaton.

Mr. Collins also presented 5 Acarids, of at least two species, collected (1909) from S. African cowhides in a tannery at Warrington.

The bee *Anthidium manicatum* captured in the garden of Wykeham House (July 11) was presented by the Professor.

It will be realized from the above account that the British Collections received unusually rich accessions in the course of the year 1910.

In addition to the above, the fine bionomic material especially illustrating the habits and the prey of predaceous insects, collected and presented in recent years by Mr. A. H. Hamm, has not yet been fully labelled and catalogued. In spite of great pressure from many directions it is hoped that this important piece of work may soon be completed and the valuable collection incorporated and acknowledged.

THE HOPE LIBRARY.

The accessions during 1910 were both numerous and important, the fine series of books and memoirs presented by Mr. G. A. James Rothney being especially valuable.

Miss Shelford has unfortunately been unable to continue her efficient help. Mr. F. C. Woodforde has very kindly

assisted the Professor by drawing up lists on which this Report has been largely based; and Mr. R. Shelford has catalogued most of the accessions and written a great part of the following pages.

DONATIONS.

The following publications and Reports were presented :—

Birmingham, Studies from the Zoological Department of the University of, vol. ii, 1910.

Bombay Natural History Society: Journal, vol. xix, pts. 3, 4, 5; xx, 1, 2.

British Museum, Trustees of the:—

Sir G. F. Hampson, Bart.: Catalogue of Lepidoptera Phalaenae, vol. x.

W. F. Kirby: A Synonymic Catalogue of Orthoptera, vol. iii, Pt. II.

Claude Morley, F.E.S.: Catalogue of British Chalcididae.

F. V. Theobald, M.A.: Monograph of the Culicidae, vol. v.

Cambridge University: Forty-fourth Annual Report of the Museum and Lecture-rooms Syndicate.

Chester Society of Natural Science, &c.: Thirty-ninth Annual Report, presented by the Professor.

Colombo Museum, Ceylon: Spolia Zeylanica, vol. vii, pt. xxvi.

Colonial Office, Entomological Research Committee of the:—
Bulletin of Entomological Research, pts. i–iii, 1910.

Instructions to Collectors (Miscellaneous Papers, No. 241).

Hastings and East Sussex Naturalist, vol. i, No. 4.

India, Fauna of British:—

G. J. Arrow: Coleoptera Lamellicornia, pt. i.

W. L. Distant: Rhynchota, vol. v, 1910.

Presented by the Secretary of State for India in Council.

Indian Museum, Calcutta:

Reports for 1908–10. Records, vol. ii, Index; vol. iii, pts. 1–4 and Index; vol. iv, pts. 1–5; vol. v, pts. 1–4.

Memoirs, vol. i, No. 4 and Index; vol. ii, Nos. 1–4; vol. iii, No. 1.

Deep Sea Asteroidea, R. Koehler, 1909.

II. The Alcyonarians of the Littoral Area, Thomson, Simpson, and Henderson, 1909.

Illustrations. Mollusca, vi.

List of Beetles, Pt. I, Cicindelinae, Annandale and Horn, 1909.

Instituto Oswaldo Cruz: 1909 and 1910, Rio de Janeiro, Memorias.

Ireland, Department of Agriculture and Technical Instruction for, Fisheries Branch:—

Monograph No. 1, 1908, by Stanley Kemp, B.A.

„ No. 1, 1909, by E. W. L. Holt.

Transferred to the Linacre Department, the author of the 1908 Memoir, on Crustacea, having presented an additional copy to the Hope Library (see p. 27).

London: Local Government Board: Report on Public Health and Medical Subjects (New Series, No. 40).

Michigan Academy of Science: 12th Report, 1910.

Natal Scientific Society, Journal of the: The Naturalist, vol. i, No. 2, 1910.

New South Wales, Department of Agriculture: Five reports on insect pests by W. W. Froggatt.

New York State Museum, Albany: Bulletins 136 and 141.

Ottawa, Experimental Farms of Canada, Reports 1910. Bulletin 66 of the Central Experimental Farm.

Owens College, Manchester: Report of the Manchester Museum, 1909-10.

Radcliffe Library: Catalogue of the Books added to the Library in 1909.

Scottish Commission on Agriculture to Canada in 1908, Report of: 1909.

Smithsonian Institution, Washington: Memoirs on Arthropoda by the following authors:—N. Banks, M. Burr, A. Busck, T. D. A. Cockerell (two memoirs), H. Coutière, D. W. Coquillett, J. C. Crawford, H. G. Dyar, G. C. Embury, J. A. Grossbeck, W. D. Pierce, Mary J. Rathbun, Harriett Richardson (four memoirs), S. A. Rohwer (two memoirs), R. W. Sharpe, R. E. Snodgrass, H. L. Viereck, C. D. Walcott, A. O. Walker, Ada L. Weckel, E. B. Williamson, C. B. Wilson.

The above list includes several fine monographs on Crustacea, and an important paper (by R. E. Snodgrass) on the thorax of the Hymenoptera.

United States Department of Agriculture, Bureau of Entomology: Publications for latter part of 1909 and for 1910, comprising 13 circulars, 21 bulletins, and 4 other pamphlets; also the monthly lists of publications.

The following authors have presented their publications to the Library:—

F. Balfour-Browne, M.A., F.R.S.E., F.Z.S.: Twelve memoirs (1903-9) relating chiefly to aquatic insects.

Jules Bourgeois: Six memoirs on Malacoderm Coleoptera.

G. H. Carpenter, B.Sc., M.R.I.A.: Four memoirs on (1) Subantarctic Collembola, (2) Pycnogonida from Red Sea and Indian Ocean, (3) The Warble-fly of the Reindeer, and (4) Biology—pure and applied.

Hamilton H. Druce, F.L.S., F.E.S.: Descriptions of New Lycaenidae and Hesperidae from Tropical West Africa (Proc. Zool. Soc. Lond., 1910, p. 356).

James Drummond, F.L.S., F.Z.S.: The Animals of New Zealand, 1909, by Captain F. W. Hutton, F.R.S., and the donor.

A. J. Grove, M.Sc.: Anatomy of "Siphonophora rosarum," part i, 1909, and ii, 1910.

Sir George Hampson: Lepidoptera Phalaenae from Northern Rhodesia. (Proc. Zool. Soc. Lond., 1910, p. 388.)

Stanley Kemp, B.A.: Decapoda Natantia of the Coasts of Ireland (Dep. of Agric. and Techn. Instrn. for Ireland, Fisheries Branch, 1908, No. 1).

Edwin Linton: Helminth Fauna of the Dry Tortugas, II. Trematodes (Carnegie Institution of Washington). This valuable monograph has been transferred to the Radcliffe Library.

R. C. L. Perkins, M.A., D.Sc., Jesus College (Director of the Agricultural Station, Honolulu): Six parts of a memoir on leaf-hoppers, a second memoir on leaf-hoppers (in conjunc-

tion with other authors), and a report on the entomological work of the Hawaiian Sugar Planters' Association (by various authors).

T. Shiraki (Agricultural College, Taihoku, Formosa) : Three memoirs on Japanese Orthoptera (one in conjunction with S. Matsumura).

Rev. T. R. R. Stebbing, M.A., Worcester, F.R.S. : Five memoirs on Nomenclature and Crustacea, including Annals of the S. African Museum, vol. vi, part iv, General Catalogue of S. African Crustacea (Pt. V of S. A. Crustacea).

Rev. Father Wasmann, S.J. : Sixteen memoirs on ants and termites.

Dr. Fr. Zacher (University of Breslau) : Three memoirs on Forficulidae.

Original papers have also been presented by the following authors:—Dr. N. von Adelung, of the Zoological Museum, Imperial Academy of Sciences, St. Petersburg (three memoirs); Dr. N. Annandale, Superintendent of the Indian Museum, Calcutta; Eustace R. Banks, M.A., F.E.S.; Dr. F. A. Bather, F.R.S.; Professor T. Hudson Beare, F.E.S.; Professor Lawrence Bruner of University of Nebraska; Dr. Malcolm Burr, M.A., D.Sc. (New College), F.L.S., &c. (two memoirs); Vicomte R. du Buysson of Paris Museum; Dr. T. A. Chapman, M.D., F.Z.S., &c.; L. Chopard (two memoirs); Dr. H. Dohrn, of Stettin Museum (two memoirs); Herbert Druce, F.L.S. (two memoirs); H. Eltringham, M.A., F.Z.S., F.E.S.; Lieut.-Colonel J. Malcolm Fawcett; T. Bainbrigge Fletcher, R.N., F.E.S.; Dr. R. Gestro of Genoa Museum; Dr. A. Griffini, of Reale Istituto tecnico di Bologna (three memoirs); Dr. R. R. Gurley, M.D., M.Sc.; A. H. Hamm (two memoirs); Dr. C. Gordon Hewitt; Dr. Karl Jordan, Ph.D., &c. (three memoirs); E. G. Joseph, B.Sc., Lincoln, F.E.S.; Professor Chancey Juday; Professor J. Graham Kerr, F.R.S.; Dr. G. B. Longstaff, M.A., D.M., New College; J. R. Malloch; S. A. Neave, M.A., B.Sc., Magdalen (two memoirs); H. Rowland-Brown, M.A., University, F.E.S.; C. Schaeffer; W. Schaus (three memoirs); Dr. A. von Schulthess Reehberg of Zurich

(four memoirs); R. Shelford, M.A., F.L.S. (four memoirs); J. W. Shoebottom; C. J. Wainwright, F.E.S.; Professor W. M. Wheeler of Harvard University.

Valuable additions to the Library have been presented by the following donors:—

Malcolm Burr, M.A., D.Sc., New College, F.L.S., &c.: one memoir by H. Dohrn, one memoir by A. Borelli, two memoirs on Bombidae by A. S. Skorikoff.

Dr. G. B. Longstaff, M.A., D.M., New College: the following volumes:—*Evolution and Adaptation*, T. H. Morgan (1908), *Manual of New Zealand Entomology*, G. V. Hudson (1892), *New Zealand Neuroptera*, G. V. Hudson (1904), and *Guide to the Study of Australian Butterflies*, W. J. Rainbow, F.L.S.

Professor R. Meldola, Hon. D.Sc., F.R.S., *Grundzüge der Zoologie*, Vols. I and II, C. Claus, 1880–2.

G. A. J. Rothney, F.E.S.: *Transactions of the Entomological Society, London*, for 1908 and 1909.

Hon. Walter Rothschild: The parts of the *Novitates Zoologicae* of the Tring Zoological Museum, published in the year 1910.

R. Shelford, M.A., F.L.S.: one memoir on Myriopoda by F. Silvestri, one memoir on Bornean Rutelidae by G. J. Arrow, one memoir on a fossil Arachnid by E. L. Gill, one memoir on Japanese Locustidae by S. Matsumura and T. Shiraki, two memoirs by R. P. Longinos Navas, S.J.

The Professor:

A bound volume of 38 original papers on Eastern Lepidoptera (1857 to 1869) presented by Dr. Alfred R. Wallace to the Professor was given by him to the Library.

The publications of the Société Entomologique de France for 1910, and of the Société Entomologique de Belgique for 1910, the publications of the Linnean Society for 1910, the *Transactions of the Entomological Society of London* for 1910, the *Journal of Economic Biology*, Vol. V (1910), *Boletín IX*, 1910, and Vol. VI of the *Memorias de la Real Sociedad Española de Historia Natural*.

The Rothney Library of works on the Hymenoptera, &c.

In addition to numerous unbound separata on Hymenoptera by Cameron and Forel and sets of the numbers of various valuable journals, a series of 92 volumes contains the following important accessions. The few duplicates in the list will be useful to workers in the Department.

W. Ashmead: Classification of Ichneumon Flies, 1900.

C. T. Bingham: 2 volumes on the Hymenoptera of British India; 1 of papers on Oriental Hymenoptera.

P. Cameron: 11 volumes of collected papers on Oriental Hymenoptera—largely those of the Rothney Collection.

Desvignes: British Ichneumonidae in the British Museum, 1856.

A. Forel: 3 volumes of collected papers on Indian and Australian Ants.

Jerdon, 1835, 1851; Sykes, 1835: 3 rare publications on Indian ants, bound in two volumes of papers.

Mayr: Memoir on the Ants of the Rothney Collection, 1878.

G. A. J. Rothney: 14 volumes of published papers, correspondence, and notes, chiefly on Indian Hymenoptera and Lepidoptera.

E. Saunders: British Hymenoptera Aculeata.

F. Smith: 10 volumes (including collected papers) on Hymenoptera, one written in collaboration with C. Horne.

Wroughton: Our Ants, 1891; Walsh: Spiders mimicking ants, 1891; Doherty: on Oriental Butterflies, 1891, bound in one volume with other papers from the Bombay Natural History Society and the Asiatic Society of Bengal.

Among the volumes not specially relating to the Hymenoptera are the following:—

A. G. Butler: New Species of Sphingidae, 1875.

Hewitson and Moore: New Indian Lepidoptera, 1879.

Douglas: World of Insects, 1856.

Ingpen: Butterfly Collecting, 1839.

Kirby and Spence's Entomology, 1865. This edition is wanting from the library of the Department.

R. Shield : Practical Hints respecting Moths and Butterflies, 1856.

Stainton's Manual, 1857.

In addition to this splendid addition to the section of the Hope Library devoted to the Hymenoptera, the generous donor several years ago presented a fine series of bound volumes of the Entomological Society's publications and has ever since presented the annual volumes, bound.

EXCHANGES.

The parts of the following journals for the year 1910 were received in exchange for the Hope Reports:—

Deutsche Entomologische National-Bibliothek.

Deutsche Entomologische Zeitschrift.

Entomologisk Tidskrift, Stockholm.

Bulletin de la Société Entomologique Suisse.

PURCHASES.

The following publications of the year 1910 were purchased for the Department:—The volume of the Ray Society, of the Zoological Record, the numbers of the Entomologist's Monthly Magazine, the Entomologist, and the Entomologist's Record.

In addition to these regular purchases there was also bought:—A Natural History of the British Lepidoptera, Vol. X, by J. W. Tutt.

E. B. POULTON.

Vol. 7. 1908-1910.

[illegible]

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